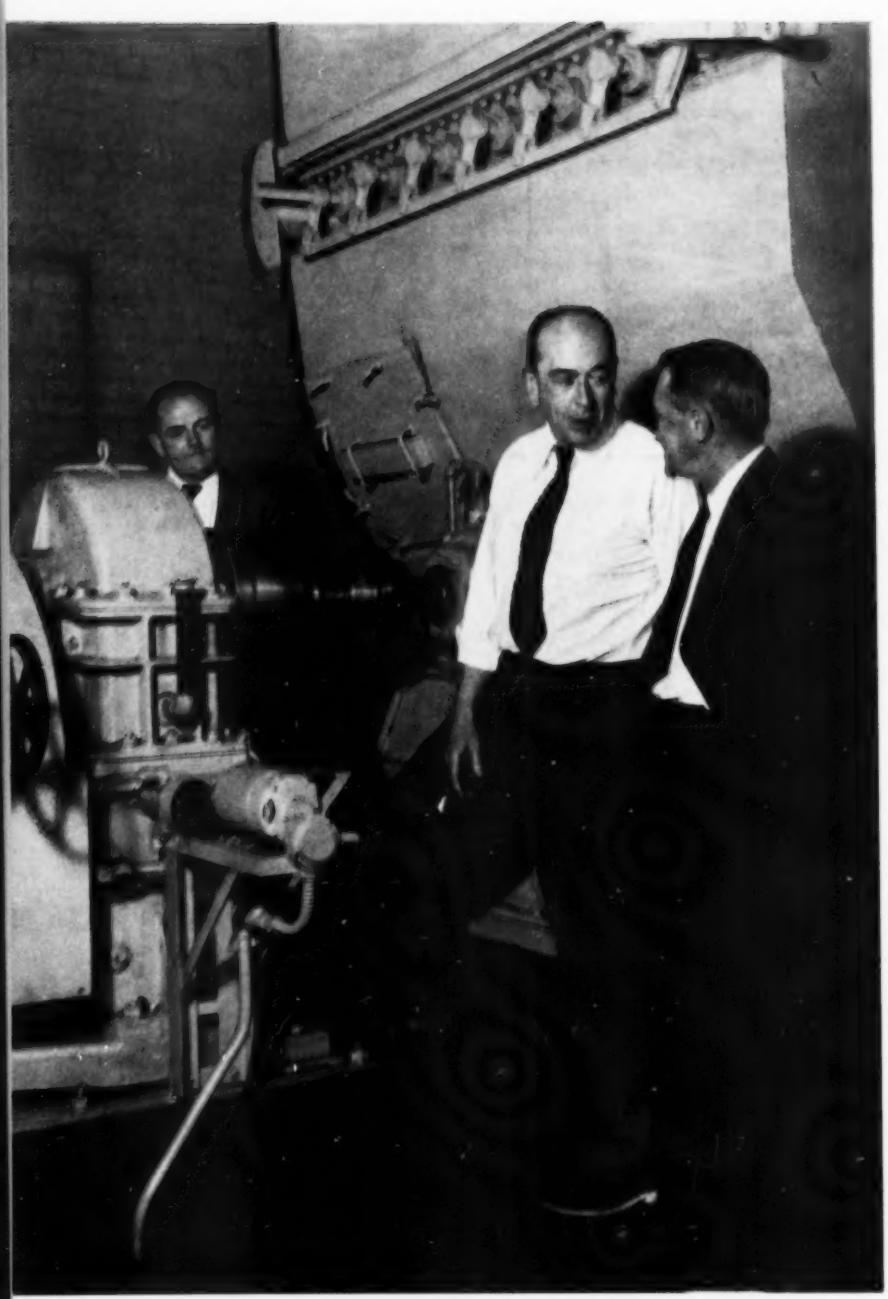
Industry and Power



June 1953

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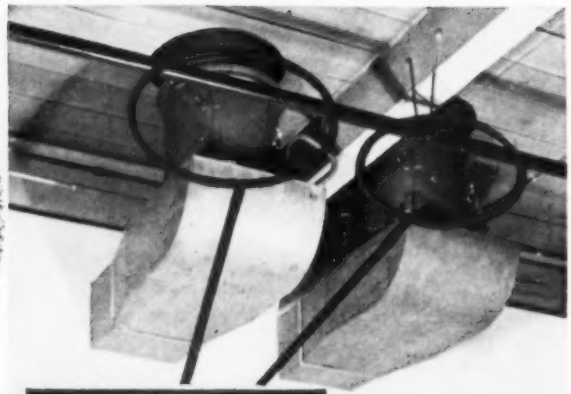
— for engineered plant services

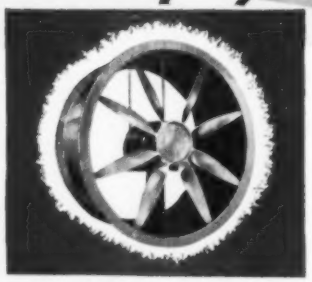
in Park Ridge, N. J.

Mittag & Volger, Inc.

RELIES

on HARTZELL fans and blowers





DUCT FAN

Sizes from 12" to 60". Belt or direct drive. Single propeller, two-propeller and multi-blades styles. As easy to install as a section of duct.

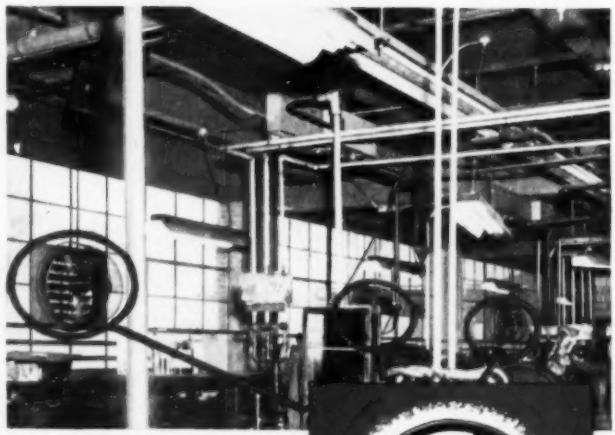
There's a Hartzell fan or blower to meet every industrial air-moving need. At the Park Ridge, N. J., plant of Mittag & Volger, Inc., manufacturers of carbon paper and inked ribbons, more than 20 different Hartzell units have proved that when air-moving problems are getting you down it pays to rely on Hartzell.

Shown at right above are the two Hartzell direct-drive duct fans which are used for rest room exhaust. The lower photo shows the three Hartzell 28" Lo-Noise Fans which provide *quiet*, efficient ventilation for the mill room. Roof ventilators and unit heaters are also counted among the Hartzell equipment giving dependable service at Mittag & Volger.

The right equipment, properly used, will beat even the toughest air-movement problem. The right equipment? Hartzell has been a leader in the industry for more than a quarter of a century because Hartzell engineering and quality workmanship are concentrated on *one* objective—more efficient, more economical air-moving equipment for *industry*. The right installation? Your nearby Hartzell field office puts the engineering "know-how" of the whole Hartzell organization right in your back yard.

Send us the details of your air-moving problem today. (And send for Catalog B-10, with details on the new line of Hartzell centrifugal blowers.)

The installations shown in this advertisement were handled by the Hartzell field office at 1440 Broadway, New York 18, N. Y.; telephone PEnnsylvania 6-0277.



LO-NOISE FAN

For installations where noise level must be kept low; special airfoil blade gives full efficiency with slow tip speed. Sizes from 24" to 60".

HARTZELL

propeller fan co.

Div. of Castle Hills Corp.

Name _____

Company _____

Street & Number _____

City & State _____

If student, check here for special information ☐

Dept. B

PIQUA, OHIO

PROPELLER-TYPE FANS • BLOWERS
ROOF VENTILATORS • UNIT HEATERS

ENGINEERING OFFICES IN PRINCIPAL CITIES

A better answer to an old drive problem

NEW BELT GIVES SUPER STRENGTH

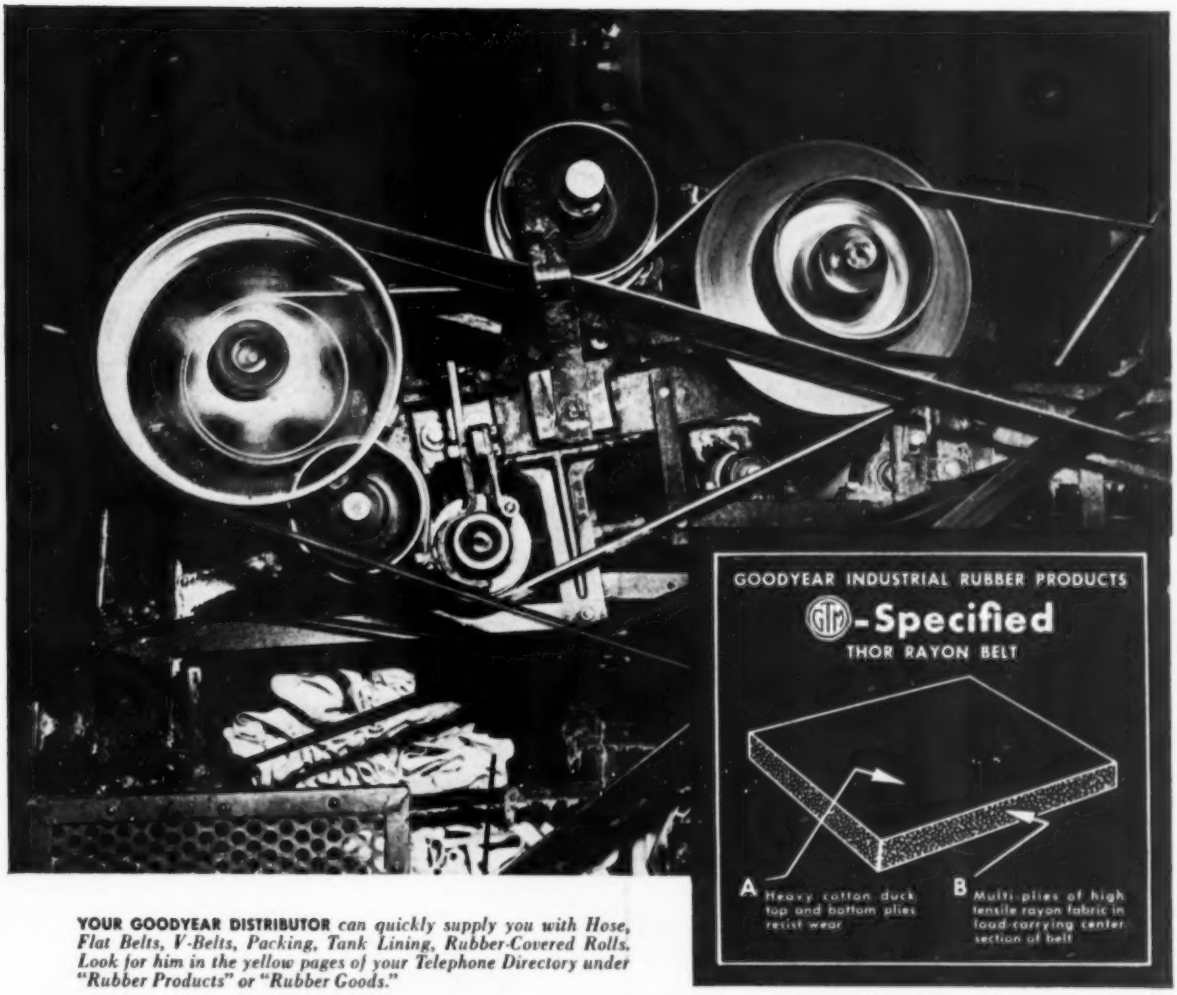
because it's built with

RAYON

ON many heavy-duty transmission belt drives — crushers, cone drives, beaters, pug mills, saws and the like—it's often impossible to apply an endless belt. Yet such drives often need more strength than you find in roll-lot, ply-type belts. Thanks to the G.T.M. — Goodyear Technical Man — there's now an answer to the problem—the NEW THOR Rayon Belt, made endless *and* in cut lengths. Look at these other advantages:

Stretch 30% less than ordinary ply belts • Outstanding ability to hold fasteners • HP ratings 10% above standard silver duck plied belts • Thinner cross-section can be used on smaller pulleys • Reduced bending stress • Mildew-inhibited throughout like all Goodyear belts.

Thoroughly tested in the field, this new, super-strong, long-lasting belt is now available for your problem drives where endless belts cannot be applied. Ask the G.T.M. about the NEW THOR Rayon Belt—see your Goodyear Distributor—or write Goodyear, Mechanical Goods Division, Akron 16, Ohio.


GOODYEAR INDUSTRIAL RUBBER PRODUCTS
GTM-Specified
THOR RAYON BELT
A Heavy cotton duck top and bottom plies resist wear
B Multi-plies of high tensile rayon fabric in load-carrying center section of belt

YOUR GOODYEAR DISTRIBUTOR *can quickly supply you with Hose, Flat Belts, V-Belts, Packing, Tank Lining, Rubber-Covered Rolls. Look for him in the yellow pages of your Telephone Directory under "Rubber Products" or "Rubber Goods."*

Thor—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio

GOODYEAR

THE GREATEST NAME IN RUBBER

We think you'll like "THE GREATEST STORY EVER TOLD" — every Sunday — ABC Radio Network — THE GOODYEAR TELEVISION PLAYHOUSE — every other Sunday — NBC TV Network

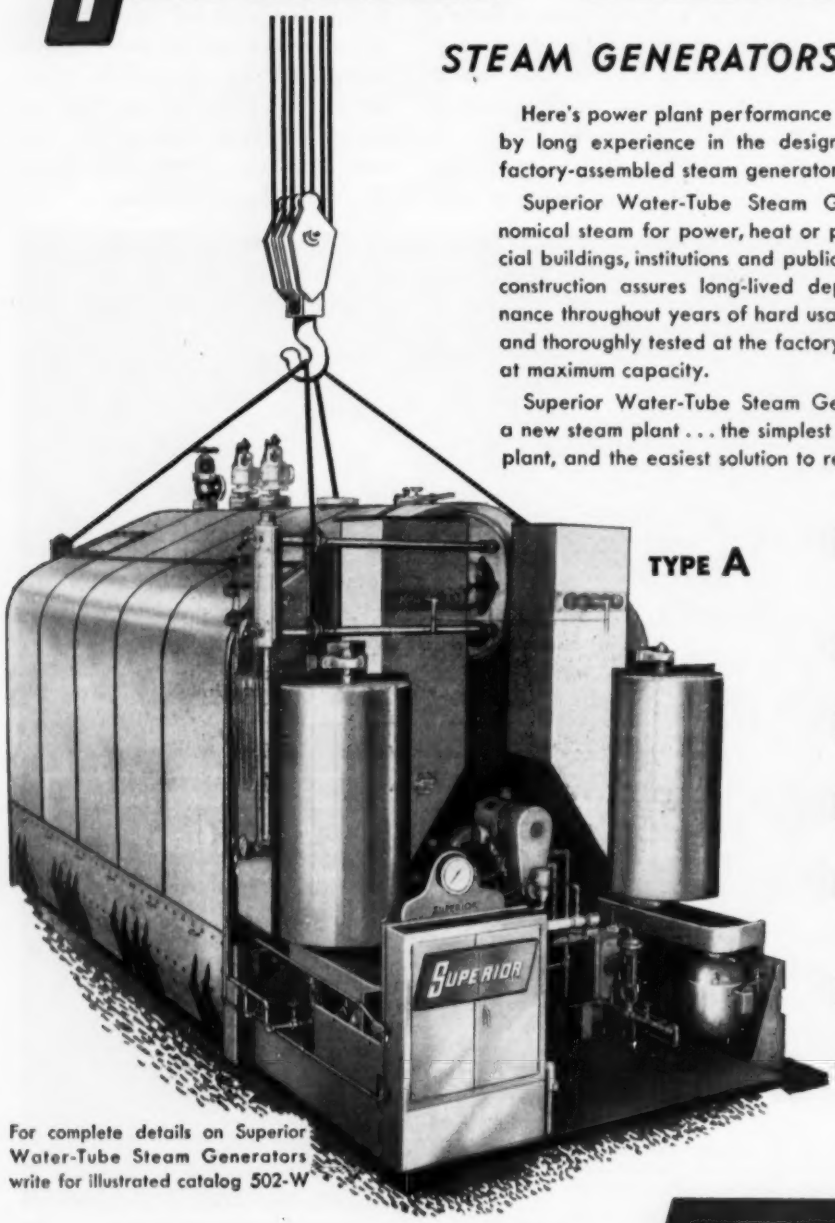
SUPERIOR WATER-TUBE

STEAM GENERATORS

Here's power plant performance in a compact package . . . backed by long experience in the design and manufacture of completely factory-assembled steam generators.

Superior Water-Tube Steam Generators provide efficient, economical steam for power, heat or process in industrial plants, commercial buildings, institutions and public utilities. Their rugged, heavy-duty construction assures long-lived dependability and minimum maintenance throughout years of hard usage. Each unit is ***performance rated*** and thoroughly tested at the factory to insure high efficiency operation at maximum capacity.

Superior Water-Tube Steam Generators are the ideal choice for a new steam plant . . . the simplest answer to expanding your present plant, and the easiest solution to replacing obsolete boilers.



TYPE A

- Completely factory-assembled and tested, Superior Water-Tube Steam Generators are backed by undivided responsibility.
- Fully automatic operation results in fuel economy . . . firing follows the load demand without waste.
- Built in 9 sizes with capacities ranging from 5,300 to 33,000 lbs. of steam per hour.
- Pressures to 400 p.s.i. . . . higher pressures on special order. Can be equipped with superheaters.
- Efficient type "A" symmetrical tube arrangement for quick steaming, even evaporation, and ease of maintenance.
- Burns any grade of oil or gas. Unobstructed fire box floor provides for installation of stoker.
- Built-in multiple induced draft fans provide cleaner, quieter, safer operation; eliminate need of expensive chimney.

For complete details on Superior Water-Tube Steam Generators write for illustrated catalog 502-W

for performance you can **BANK** *on*

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

Industry and Power

VOLUME 64 **June 1953** NUMBER 6

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HILCO

LUBE and FUEL OIL PURIFICATION . . .

GET RID OF DIRTY OIL . . .
GET LOWER OPERATING COSTS
LONGER EQUIPMENT LIFE

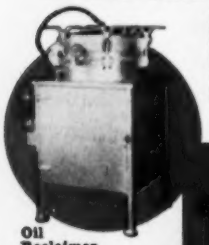
HILCO oil purification means complete oil purification! With a HILCO you get removal of sludge, acids, carbon, water and fuel dilution economically and efficiently. HILCO operation is continuous, all-electric and automatic.

Clean oil at all times reduces down time, increases production and HILCO units pay for themselves in savings.

HILCO offers a wide range of oil purification units . . . one to meet your needs. Write us about your equipment . . . and get recommendations at no obligation.

● *THERE'S A* **HILCO** *FOR EVERY LUBRICATION AND FUEL OIL FILTERING PROBLEM*

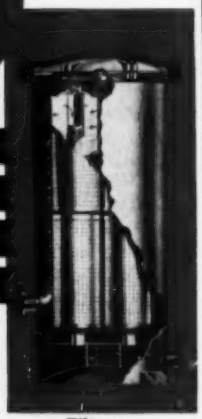
HILCO has 25 years experience in oil purification. Let this experience work for you.



Oil Reclaimer

PURIFIERS
FILTERS
RECLAIMERS
CONDITIONERS

A complete range of sizes and systems for oil purification.



Filter

★ *WRITE FOR* **FREE** *LITERATURE NO OBLIGATION ON YOUR PART*

THE HILLIARD CORPORATION
105 W. FOURTH ST.
ELMIRA, N. Y.

IN CANADA — UPTON-BRADEEN-JAMES, Ltd.
990 Bay St., Toronto, 3464 Park Ave., Montreal

acorns

. . . recently announced . . . worth watching

Cured Plastics

● Scientists have found that a stream of electrons toughens polyethylene, one of the most promising of the plastics to find recent widespread acceptance. A beam from an x-ray machine cures plastics so that they can handle solvents which previously would have been highly destructive. In addition, curing raises the flow temperature of the plastic substantially.

Turpentine Base

● Turpentine is the basic raw material for new synthetic lubricants. Such lubricants have heretofore been derived from organic chemicals which are in limited supply and which are finding increasing use in other fields such as plastics. Turpentine is available in large quantities and should become more important as this new process becomes commercially available.

Still Smaller Amplifiers

● The electronics industry goes on shrinking amplifiers, seemingly never content with the smallest of the small. Latest word is about tiny wafers, termed dielectric amplifiers. The units are about 1/8 in. square and 7/1000 in. thick. Among the promised applications of the midgets are automatic control equipment for industry, including photo-electric counting mechanisms and high speed servomechanisms.

Super Rustfree Steels

● A patent has been granted on a large group of electro steel alloys which display remarkable properties in tensile strength, yield strength, corrosion resistance, and heat resistance. The work on the "SR" steels had its foundation in Germany before World War II. They are true steels, containing less than 50 per cent alloying material; the super rustfree steels do not rely on the highly critical elements such as cobalt, columbium, titanium, and zirconium. They use reduced amounts of nickel compared to the conventional alloys of comparable grade. They are much less expensive than many high alloys and are competitive with some stainless steels.

Synthetic Perspiration

● Valeric acid, butyric acid, acetic acid, and salt are put together to make synthetic perspiration by researchers studying the effects of perspiration on finishes. Sweating it out as they do, the investigators use the ersatz perspiration to accelerate the progress of investigation into corrosive and etching effects on finishes.

Ultra Fast Combustion Pictures

● High speed motion pictures are being used to study the combustion of various fuels in diesel, gas-diesel, and gas engines. Taking 20,000 frames per second, hitherto unknown burning characteristics are observed for engineering analysis of fuels and engine design.

Computing Smell

● Understanding is the forerunner of progress and the new understanding of smells recently announced heralds future developments in the control of odors. Scientists have constructed a computing circuit analogous to the human olfactory nervous system. With smelling thus reduced to an engineering science, the researchers' goals include new and improved industrial products.

Perpetual Motion

● Perpetual is the stream of news that trickles along about new approaches to the age-old quest for ceaseless motion. A patent has been granted on a rotary heat engine operated through small temperature differences induced by atmospheric energy in the machine's parts. No immediate claim is announced for the device over existing commercial power sources although some hope is held out that Junior may find one propelling his toy boat over the choppy bathtub sea in the not-too-distant future.

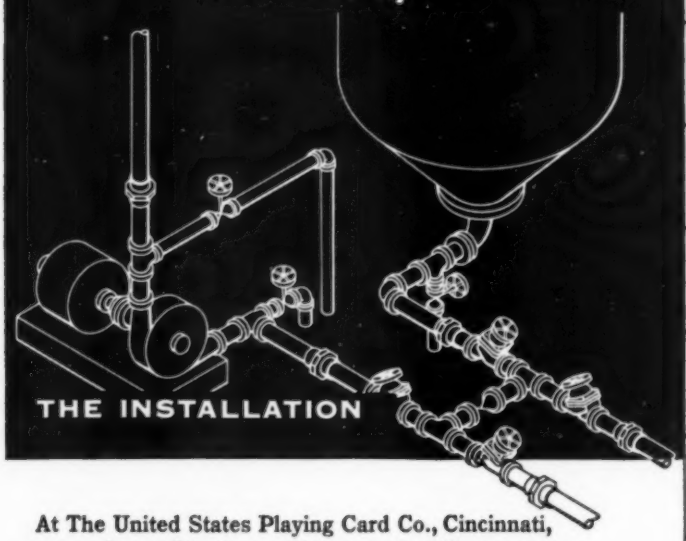
Atomic March

● Atomics continue their steady advance upon industry. Reactors are being acknowledged more widely daily as functioning realities. Though they are unwieldy, expensive, and unique in many respects, they remain the most concentrated source of energy yet devised by man. Westinghouse has announced a new plant scheduled for completion this year to be devoted exclusively to the manufacture of the unique equipment that is used in atomic power plants.

What a Difference in Valve Behavior

...on Heavy Coating Liquids

for example



THE INSTALLATION

At The United States Playing Card Co., Cincinnati, using Crane Diaphragm Valves in handling paper coating "enamels" from storage tanks to pumps.

VALVE SERVICE RATINGS

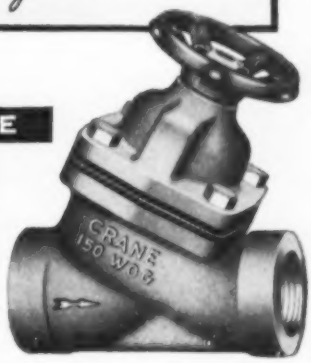
SUITABILITY:	None other like it
FEATURES:	Fluid can't get into bonnet
MAINTENANCE COST:	None
SERVICE LIFE:	No sign of wear after 3 years
OPERATING RESULTS:	Trouble and waste stopped
PRICE:	O.K. — no premium
AVAILABILITY:	Crane Catalog item—No. 1610

THE CASE HISTORY

Previously, ground plug cocks and conventional gate valves were used. During normal shutdowns the heavy coating liquid would build up on seating surfaces, in stem threads and working parts. The cocks and gates would "freeze up"; were hard to operate, couldn't be shut tight. Recurring maintenance, cleaning, and replacements were a costly, annoying problem.

Switching to Crane Diaphragm Valves solved the problem. Their sealed-to-fluid bonnet and soft disc insert did the trick. None of the 48 Crane valves installed beginning more than 3 years ago, has needed service of any kind. They continue to operate freely and easily.

THE VALVE



There are many more ways you can benefit by complete, dependable isolation of fluid and valve working parts. Crane Packless Diaphragm Valves are equally effective under corrosive conditions, and on erosive fluids—sludges, slurries, etc. They also keep your product contamination-free. Choose these valves to your needs from a wide variety of body, disc, disc-insert, diaphragm, and lining materials. See your Crane Catalog or local Crane Representative.

THE BETTER QUALITY...BIGGER VALUE LINE...IN BRASS, STEEL, IRON

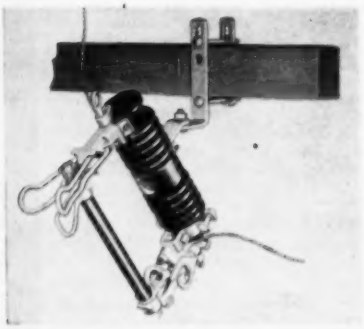
CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

new equipment

. . . new developments

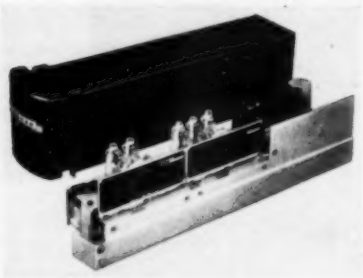


Fuse cutout features high interrupting capacity

F10 To meet the need for an economical, high interrupting capacity distribution cutout, Line Material Co. has designed the type HCO, 100 amp open type, heavy duty unit. It is rated at 5, 7.5, and 15 kv, with an interrupting capacity of 8000 amp. Operation is based on the principle of single venting of the fuse tube on low faults, and double venting on high faults to provide for proper clearing through the complete fault range. By relieving high pressures, the double venting provides minimum stress on the cutout during operation at maximum interrupting capacity.

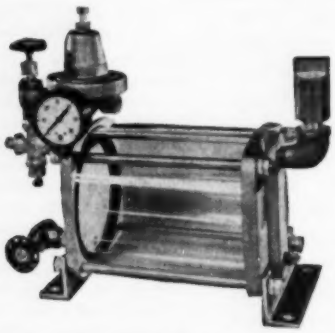
Pipe insulation combines many desirable features

F11 Gustin-Bacon Manufacturing Co. has developed a pipe insulation composed of fine, blown glass fiber, bonded with phenolic resin and molded into one piece sections. Known as Ultrafine, it is recommended for heated piping up to 350 F, as a second insulating layer for high temperature piping, and also for low temperature applications. Advantages include high thermal efficiency, light weight, flexibility, resiliency, and resistance to breakage. It is insoluble in water, can be cut with an ordinary knife, and can be finished as desired. Technical information is provided in a 6-page bulletin.



Electronic control system eliminates distance factors

F12 Manning, Maxwell & Moore, Inc., has developed an electronic process control system for measuring and controlling temperature, pressure, differential pressure, liquid level, and flow. According to the manufacturer, there is virtually no lag in the transmission signal. Controllers can be installed at any distance from the process area. Control components are completely standardized to permit interchanging at the panel, regardless of the variable under control.



Dispenser provides close regulation of fluid flow

F13 For feeding oil and other fluids to elevated, distant, and inaccessible points, Oil-Rite Corp. has developed a dispenser operated by air pressure. Discharge can be controlled within wide limits by adjusting air pressure, thus making the unit desirable for conditions demanding close regulation. Applications include spray oiling, and use as the central reservoir of single-line, low-pressure, air-operated oiling systems. A transparent plastic reservoir permits full visibility of fluid supply. Units are available in capacities to 2 gal. Construction is shown in a data sheet.

Unit automatically loads heat treating furnaces

F14 To increase and improve production, and at the same time reduce labor costs, Michigan Crane & Conveyor Co. has designed a heat treating furnace loader to automatically remove material from a hopper and discharge it in metered quantities into an endless belt type furnace. A series of synchronized vertical-moving pushers, cut on a 30 deg angle, remove parts from the hopper, raising them to the next level and causing them to roll off by gravity. The material continues to be elevated and transferred through a series of cycles until discharged into the furnace.

Air-gas mixer features adjustable air jet

F15 To provide a simple adjustment to meet various burner requirements, Eclipse Fuel Engineering Co. has developed an air-gas mixer with an adjustable air jet. Known as Vari-Set, it features a Venturi throat which is said to eliminate dismantling of jets

(Continued on page 12)

NOTE—Each new product item has a key number for your convenience in asking for additional, detailed information. Insert this number on return post card on page 115.

Latest type Cooper-Bessemer 1500 hp opposed-action air compressor, installed in Boeing's Research Laboratory, Seattle. Capacity is automatically, accurately controlled at any discharge pressure up to 295 psig.

Over 6 million Cooper-Bessemer compressor horsepower NOW IN USE!

Modern air power on land

HELPS GAIN NEW POWER IN THE SKY!

HERE are two kinds of air power—Boeing's amazing new B-47 Stratojet, shown in a Jato takeoff, and a modern Cooper-Bessemer motor-driven air compressor. Installed in Boeing's Research Laboratory almost a year ago, this big compressor supplied air under pressure for testing many of the B-47 parts, will go on year after year contributing to Boeing's broad development program.

The latest Cooper-Bessemer compressor developments offer new advantages, new economies to plants everywhere . . . wherever air is a tool. For example, modern opposed-action design means greater space-saving compactness, vibration-free operation, higher efficiency, and longer life with less maintenance.

So when it comes to air or power, it will pay you to write for the latest Cooper-Bessemer bulletins. Find out about the *new* things being done by one of America's *oldest* builders of engines and compressors.

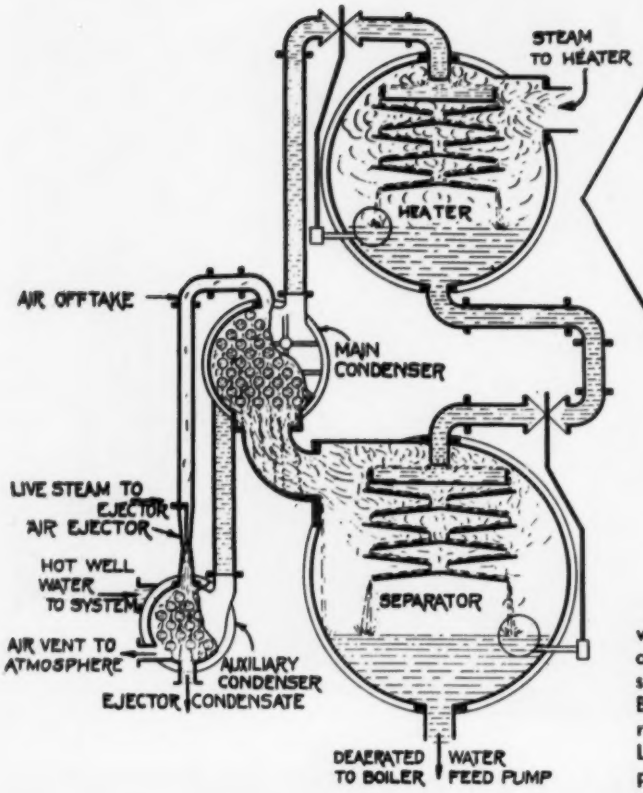
The Cooper-Bessemer Corporation

MOUNT VERNON, OHIO — GROVE CITY, PA.

New York • Chicago • Washington • San Francisco • Los Angeles • San Diego • Houston • Dallas • Odessa • Pampa • Greggton • Seattle • Tulsa • St. Louis • Gloucester • New Orleans • Shreveport
Cooper-Bessemer of Canada, Ltd., Halifax, N. S.

DIESELS • GAS ENGINES • GAS-DIESELS • ENGINE-DRIVEN AND MOTOR-DRIVEN COMPRESSORS • HIGH PRESSURE LIQUID PUMPS

DEAERATION

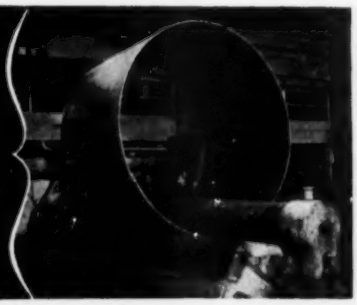


THE FIRST DEAERATOR, DEVELOPED AND BUILT BY ELLIOTT IN 1918

After much research and experimentation in the virgin field of processing feedwater for the removal of oxygen, Elliott engineers in 1918 developed, built and sold the first practical commercial deaerating unit. By 1924 the supreme value of the achievement was recognized in the award to W. S. Elliott of the Edward Longstreth medal by the Franklin Institute, Philadelphia . . . With this commanding lead, backed by valuable pioneering experience, Elliott engineers have continued to set the pace in deaeration development.

HOW ELLIOTT BUILDS DEAERATING HEATERS

All the work is done right in the Elliott shops. Rolling of shells, welding and fabricating of parts is all handled by Elliott personnel. It's actually custom tailoring in metal, for every unit is built to fit its job.



Rolling a fair-sized shell.

ASME-approved automatic welding is used wherever possible.

ELLIOTT Company

DEAERATOR AND HEATER DEPARTMENT

H2-2

has come a long way!

1953 THE ELLIOTT DEAERATING HEATER OF TODAY

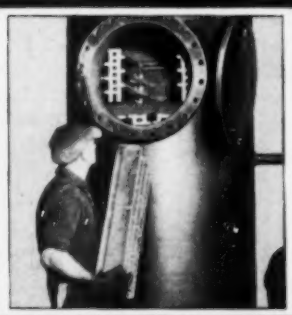
The modern Elliott deaerating heater combines the three stages of the deaerating process—heating, deaerating and venting—within a single shell, thus eliminating headroom problems and simplifying construction. The tubular vent condenser is replaced by a spray pipe and vent hood, both of stainless steel, which perform the functions of the clumsy, outmoded vent condenser with no maintenance other than occasional inspection. Here in itself is a major saving.

The entire heating section, and in fact all parts in contact with corrosive water, are of stainless steel. Trays, too, are of stainless steel—not only corrosion-free, but far lighter in weight—another factor for lower maintenance.

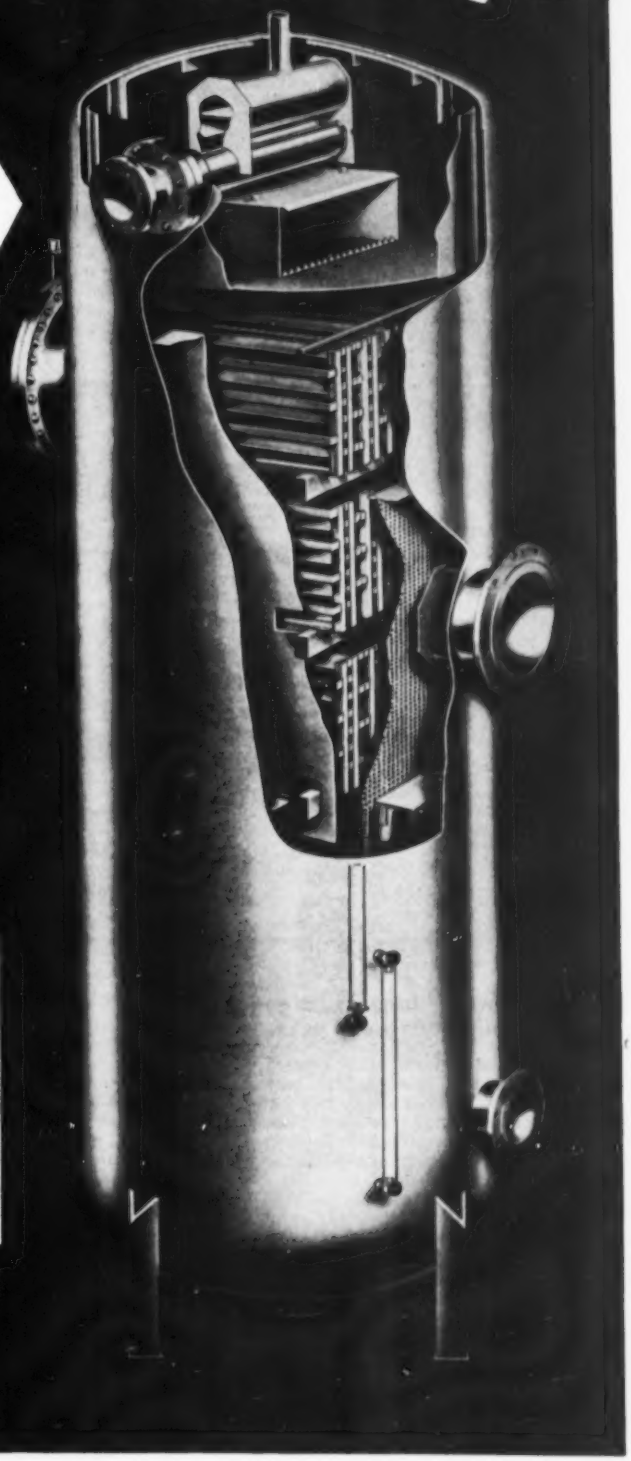
The picture at right shows the tray-type unit. The Elliott spray-type unit, developed largely for marine use, is also available.

For full details on Elliott deaerating heaters contact your local Elliott representative or write Elliott Company, Jeannette, Pa.

Tack-welding a baffle-plate in place before final welding.



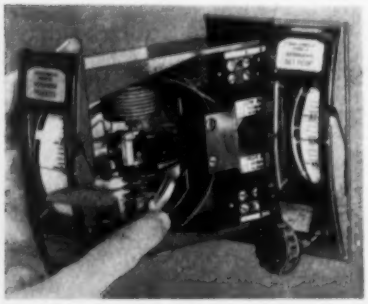
Stainless steel trays are no burden at all in manual handling.



new equipment

(Continued from page 8)

or sleeves. The unit can be adjusted after installation to meet such operating conditions as pipe roughness, gas pressure losses in elbows, and size and type of burner port variances that cannot always be determined in advance. The unit is designed for any type of gas. Specifications are tabulated in an available bulletin.



Miniature indicator features built-in alarms

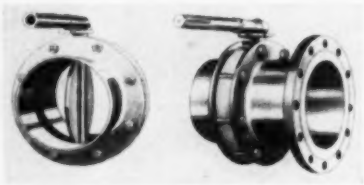
F16 Fischer & Porter Co. has designed a miniature indicator for mounting in either graphic or conventional panels. The unit, first in a series of Ratographic miniature instruments, has a total scale length of 5¾ in. calibrated from 0 to 100. It is positioned by a pneumatic signal from any remotely located primary or secondary instrument. Combinations of visual and audible alarms are available to warn the operator when the variable is outside required operating limits. Flexibility of function is said to permit its use for a variety of controlling, indicating, and warning applications with an unusually small inventory of parts.

Trap provides greater capacities

F18 To meet the demand for a larger size in the standard series of traps with horizontal and opposite pipe connections, Armstrong Machine Works has introduced the No. 814 side inlet, side outlet trap. Capacities are to 6800 lb per hr, depending upon pressure. Pressure range is 0 to 250 psi. Threaded connections are 1 or 1¼ in.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.



Valve features resilient seat

F19 Keystone Tool Corp. has developed a butterfly valve to hold pressure or vacuum, and also to shut off completely against suspended solids. A resilient, neoprene seal ring exerts positive pressure against the butterfly disc. It is not subject to scoring by abrasive particles, and if a bit of solid is caught between the disc and the seat, the seat deforms around it. The valve can be mounted between standard flanges, and is available with screw, welding, or flanged ends. Units are designed for operating pressures up to 150 psi, in sizes from 2 to 12 in.

Selenium rectifier features many advantages

F20 An improved selenium rectifier, the H-VW-M, has been developed specifically for the electroplating industry by Hanson-Van Winkle-Munning Co. Glass wool dust blocks filter incoming air. Control and power transformers are calculated on the basis of convection cooling. A single-knob control switch prevents unbalancing of phases. A standard motor starter, used in place of a starting contactor, provides overload protection on the a-c side as well as low voltage release. The unit delivers a full wave, six-phase current with a theoretical ripple of 4.5 per cent. A-c input is dual — 220/440 v, three phase, 60 c. Units are available in self-contained or remote models.

(Continued on page 16)

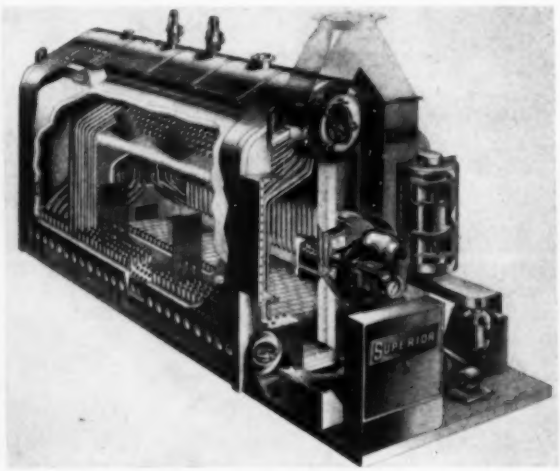
Package water-tube steam generator features divided second pass

F17 Reduced installation costs are an important feature of a factory-assembled, water-tube steam generator designed by Superior Combustion Industries, Inc. Units are built on a structural steel base, thus eliminating the need for brick settings, special foundations, or pits. Refractory, insulation, burner, controls, inter-connecting piping, and wiring are installed at the factory.

Nine sizes, for pressures up to 400 psi, range from 5300 to 33,000 lb steam per hr. Fully automatic firing with oil, gas, or stoker coal is available. Units can be furnished for permanent outdoor installation.

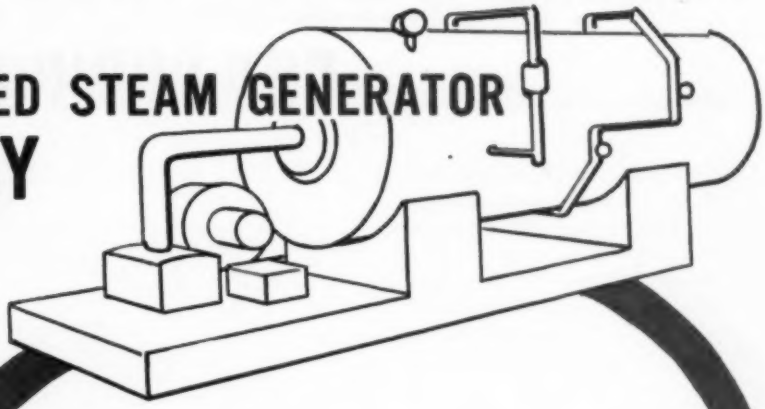
Quick steaming properties are said to result from the "A" type construction used. In addition, the tube layout protects the steam drum from direct impingement. Ample hydrostatic head assures rapid circulation and quick response to fluctuating load demands. An unobstructed firebox floor simplifies details of installation.

A multiple-fan, induced draft system provides cleaner, quieter operation, and insures positive purging of the combustion chamber before and after firing. Dual induced draft fans and a divided second pass provide flexibility of firing range.



Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT

SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE

FUEL SAVING . . . CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION

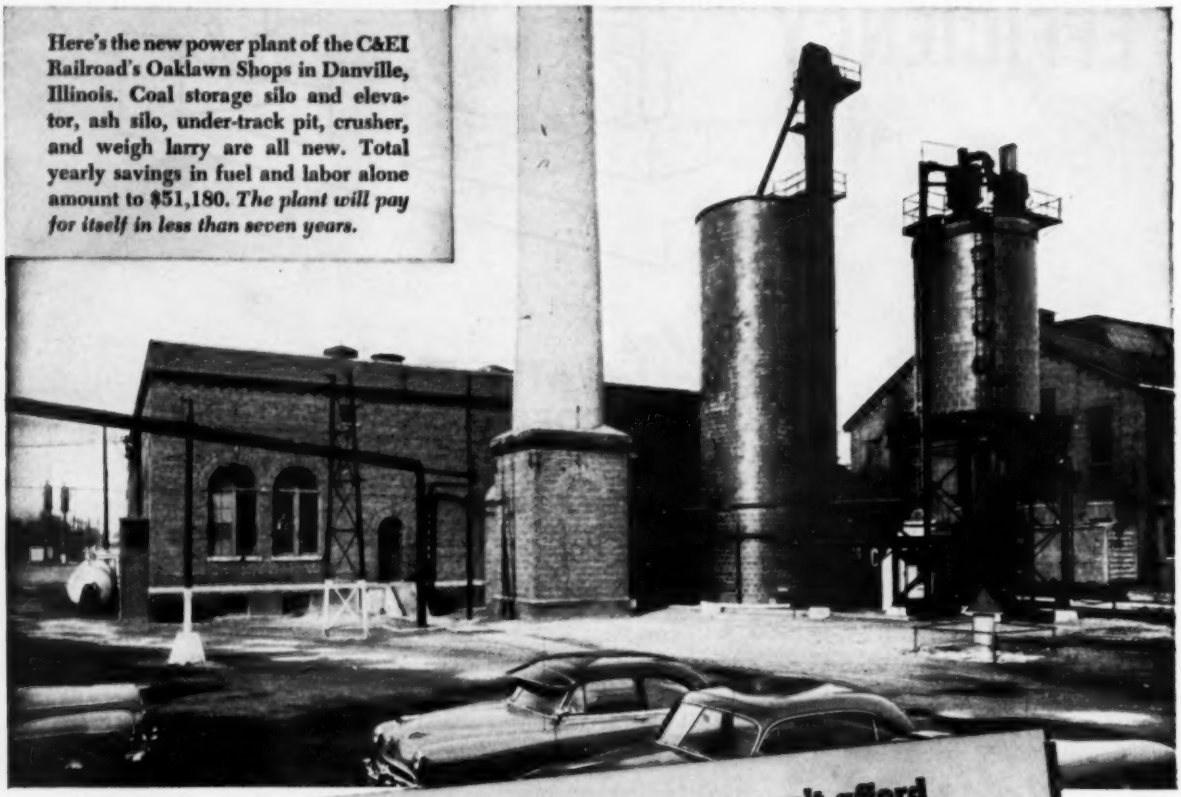
6218 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE *Nalco* SYSTEM • Serving Industry through Practical Applied Science

"BURNING COAL THE MODERN WAY CUT OUR POWER COSTS

Here's the new power plant of the C&EI Railroad's Oaklawn Shops in Danville, Illinois. Coal storage silo and elevator, ash silo, under-track pit, crusher, and weigh larry are all new. Total yearly savings in fuel and labor alone amount to $51,180. *The plant will pay for itself in less than seven years.*



If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

FOR HIGH EFFICIENCY
FOR LOW COST

$51,000 A YEAR!

UP-TO-DATE COAL INSTALLATION CUT FUEL CONSUMPTION 20.3% . . . LABOR FORCE 47%!"

says Mr. George E. Bennett, Supt. Motive Power, Chicago & Eastern Illinois Railroad.

"We recently modernized the power plant at our Oaklawn Shops in Danville, Illinois. Three boilers now do the work that formerly required seven. We've realized great savings in labor and fuel. It's proved to us that, when it comes to both economy and efficiency, you just can't beat *bituminous* coal burned with modern equipment."

This is a view of the firing aisle showing the spreader stokers which are fed by a weigh larry. Man-days per week required to operate the plant have been reduced from 112 to 59! The three new boilers were installed one at a time as the old units were removed, thus not interrupting the operation of the shop.

● Low cost—high dependability—easy, safe storage—coal gives you all these big advantages no matter how you burn it.

But you can get much more!

Cut labor costs to a minimum—handle coal and ashes with automatic equipment . . . burn coal in a *modern* combustion installation—you'll get more BTU's, more steam for every dollar spent.

If you're planning to modernize, or if you're building a new plant, call in a consulting engineer. He'll show you how modern coal equipment, designed to meet your specific needs, can effect a sharp reduction in your operating costs.

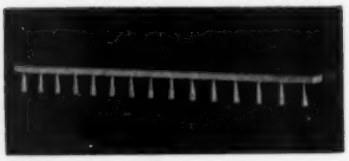
And remember, with coal you have a future dependability no other fuel can offer. America's coal reserves assure an abundant fuel supply far beyond the productive lifetime of your plant. And to mine this coal, America has a highly mechanized, progressive coal industry. Few American industries of any type can match the productivity and increasing efficiency of this nation's coal-mining companies. You can count on coal's economy, on coal's dependable supply—right now and for the future, too!

BITUMINOUS COAL INSTITUTE
A DEPARTMENT OF NATIONAL COAL ASSOCIATION
WASHINGTON, D. C.

YOU CAN COUNT ON COAL!

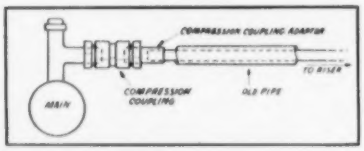
new equipment

(Continued from page 12)



Electrostatic neutralizer features many advantages

F21 Simplicity of design and effectiveness are important features of an electrostatic neutralizer developed by The Herman H. Sticht Co., Inc. Known as Magic Wand, it is said to improve processes and eliminate electrostatic fire and explosion hazards. No external source of power is required. Static is efficiently neutralized regardless of the voltage of electrified stock or of processing speed. An 8-page bulletin discusses principles of operation.

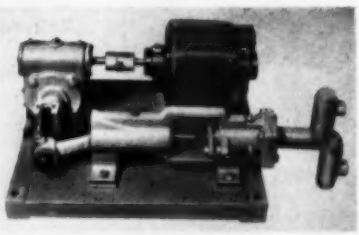


Plastic pipes for transmission of natural gas

F22 Carlon Products Corp. has designed two types of plastic pipe especially for the gas industry. Advantages include corrosion resistance, greater carrying capacity, elimination of interior build-up, elimination of electrolysis, high strength and durability, and cheaper installation. Type GR rigid pipe for new service lines features high impact strength and effective fiber stress of over 3600 psi. Type GF flexible pipe is designed to be inserted directly into old corroded service lines after proper reaming. Superior flow characteristics provides a comparable volume to the meter. The drawing illustrates how it is used.

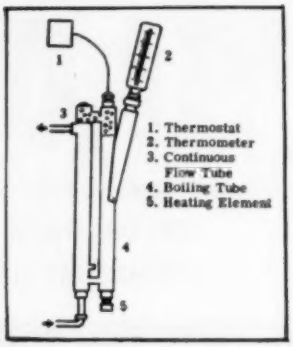
TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.



Compact chemical pump features low cost

F24 Orchem Pump Div. of Orlich Bros. Machine Works has developed an inexpensive, compact chemical pump for such applications as water softening and boiler treatment. Known as Little Giant, it can be used for applications up to 800 psi. A new ball and seat design is said to feature efficiency and economy. Suction and discharge sides consist of integral ball and seat units. A standard stroke adjustment permits accurate control and repeatability from 0 to 100 per cent of rated capacity. A separate gear reducer permits use of standard motors for replacement.



Instrument controls moisture for conditioned air

F25 Moisture-sensitive elements have been eliminated in a humidity control developed by Niagara Blower Co. for use in its air conditioning systems. In the system used by this company, moisture in the conditioned air is governed by concentration of an absorbent liquid. Operation of the control is based on a direct relationship between boiling point and concentration of the absorbent liquid. Samples are heated to boiling point and a thermostat, which is set to the desired boiling temperature, controls the concentrator. Since a small variation in concentration causes a relatively large change in the boiling point, the instrument is said to be extremely accurate.

Conveyor belt designed for steep incline

F26 Packages and cartons can be moved up and down grades as steep as 55 degrees as a result of a conveyor belt developed by The B. F. Goodrich Co. Called Ribflex Griptop, the belt features a special rigid and cross-cut rubber surface which provides

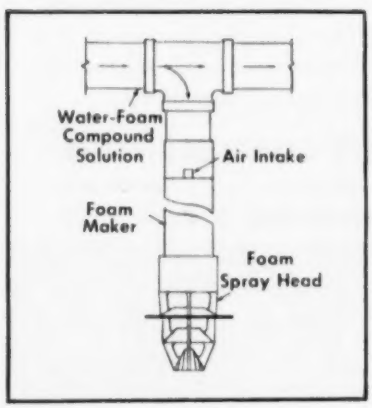
(Continued on page 20)

System discharges foam spray for oil and chemical fires

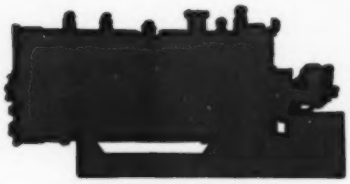
F23 Overhead protection of medium size petroleum and chemical hazards is provided by a spray-type foam maker developed by Pyrene Manufacturing Co. for use in a fixed system. Water and foam compound is supplied to the foam maker at a pressure of 30 psi or more. The solution entering the unit aspirates air, and all ingredients are intimately mixed. The foam is then distributed in a fully covered circular pattern. Units also are approved for water discharge alone. According to the manufacturer, water will not adversely affect the foam already deposited.

Compound can be introduced into the main water line by proportioning tank, around-the-pump proportioner, or pressure-line inductor. Portable playpipes, supplied through the same lines, can be used to augment fixed systems.

The spray unit should be located at least 4 ft above the hazard. Coverage ranges from 10 to 20 ft in diameter, depending upon operating pressure. Two models provide water rates from 22 gpm at 30 psi to 40 gpm at 100 psi, and 33 gpm at 30 psi to 60 gpm at 100 psi.

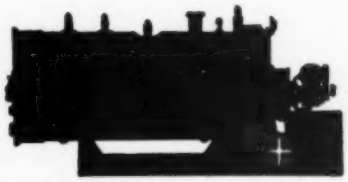


HOW SUPERIOR SOLVES YOUR STEAM PROBLEMS



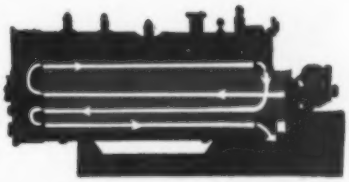
A COMPLETE PACKAGE

Completely factory-assembled and tested, a Superior Steam Generator is backed by undivided responsibility.



INDUCED DRAFT THAT'S BUILT-IN

... eliminates need of an expensive chimney ... Multiple fans draw evenly on all tubes, reducing maintenance.

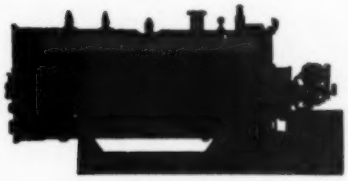


4-PASS, DOWN-DRAFT DESIGN

High gas velocities produce high efficiency. Down-draft design promotes rapid evaporation, quicker steaming.

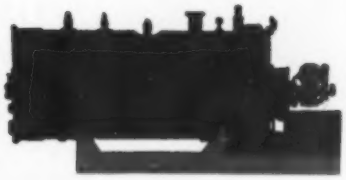
AMPLE HEATING SURFACE

A minimum of 5 sq. ft. of heating surface per boiler horsepower assures maximum efficiency at full rated capacity.



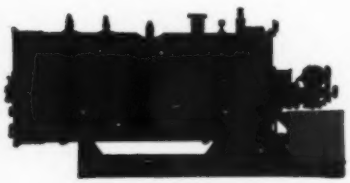
RESERVE CAPACITY

Greater steam space and large evaporating surface provide ample reserve capacity & better than 99% dry steam.



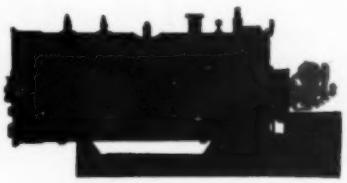
NO EXPENSIVE FOUNDATION

Built on a rigid channel iron base, a Superior Steam Generator needs only a floor capable of supporting its weight.



BUILT-IN CONTROLS

All controls essential to completely automatic operation are factory-wired into an easily accessible control panel.



BURN OIL, GAS, OR BOTH

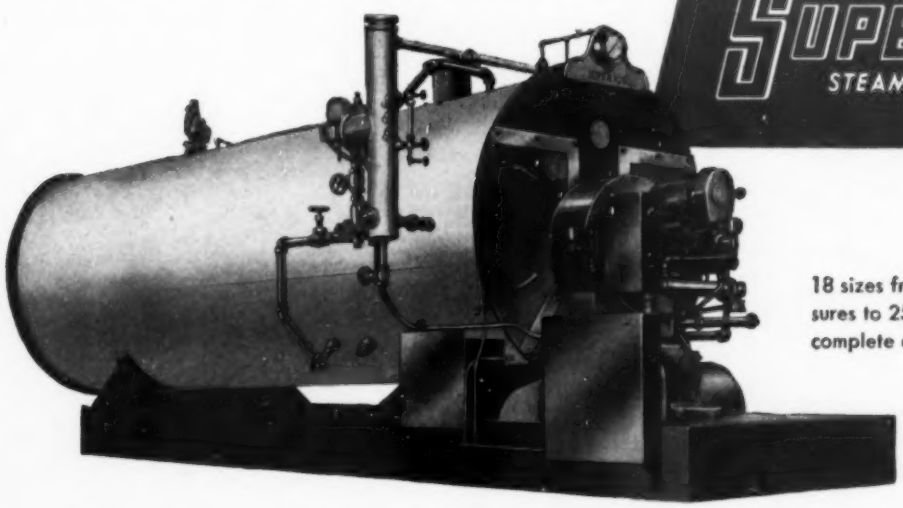
Superior Burners burn oil or gas or a combination of both ... changing from one fuel to the other in seconds.

Superior Steam Generators are the ideal choice for a new steam plant ... the simplest answer to expanding your present plant ... the easiest solution to replacing obsolete boilers.

Guaranteed to develop maximum rated capacities at thermal efficiencies in excess of 80%, their design embodies features which insure long-lived dependability and maximum fuel economy.

for performance you can **BANK** *on*

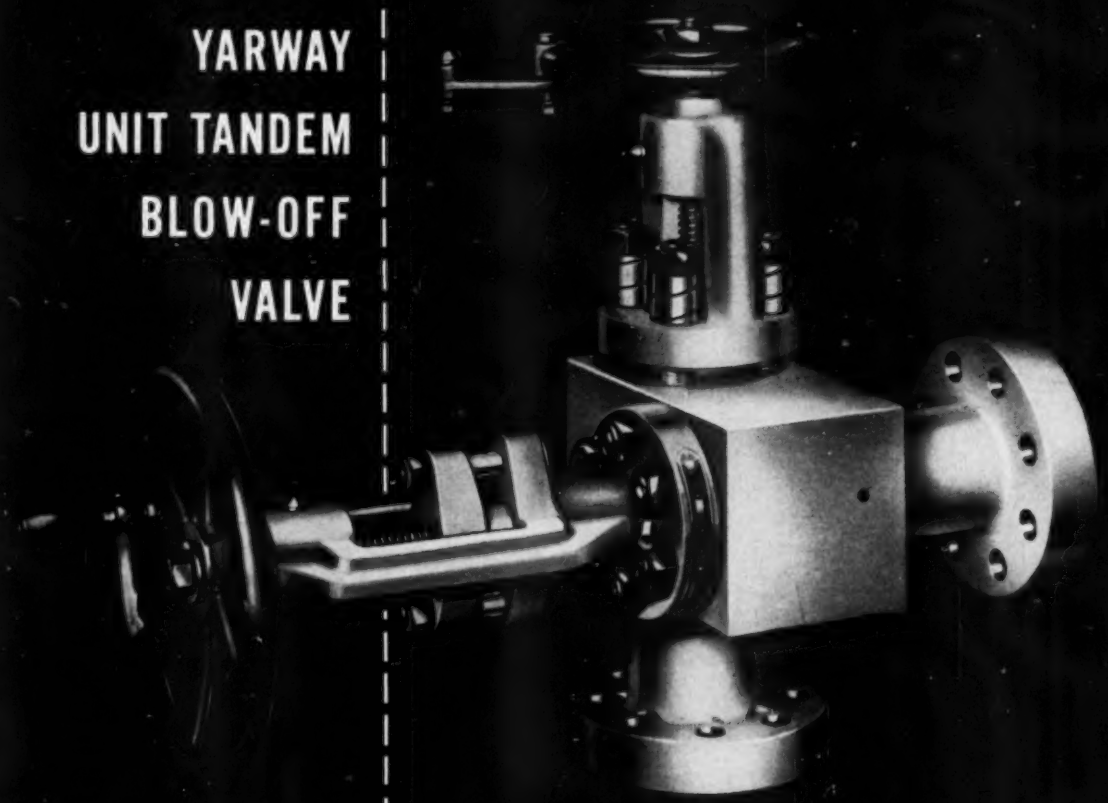
SUPERIOR
STEAM GENERATORS



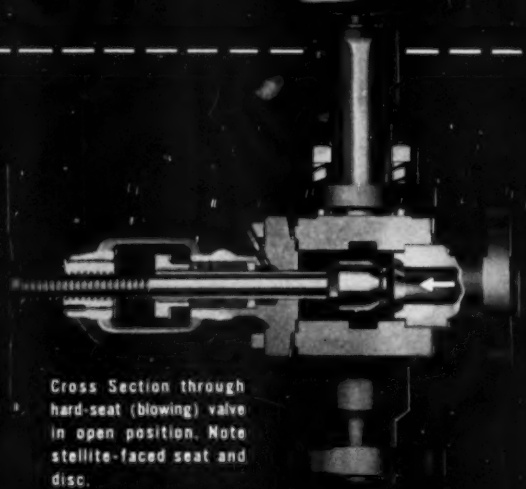
18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 502.

SUPERIOR COMBUSTION INDUSTRIES INC. TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

YARWAY UNIT TANDEM BLOW-OFF VALVE

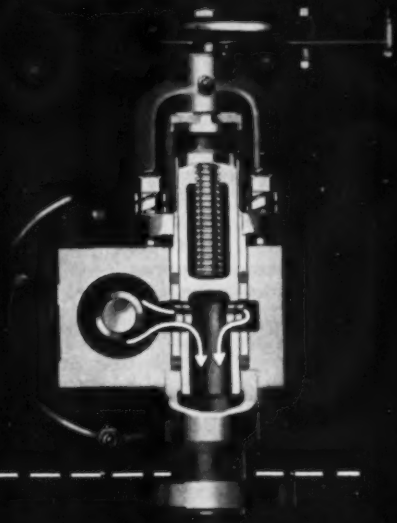


CROSS SECTION HARD-SEAT VALVE



Cross Section through hard-seat (blowing) valve in open position. Note stellite-faced seat and disc.

CROSS SECTION
SEATLESS VALVE



Cross Section through seatless (sealing) valve in open position. (On pressures over 1500 psi two hard seat valves are recommended.)

RUGGEDNESS
...WHERE YOU NEED IT

A one-piece forged steel block serves as the common body for both valves in Yarway Unit Tandem Blow-Off Valves.

You get rugged strength where you need it... added protection for your high pressure boilers.

Whether in times of emergency, normal blowdown service, or acid washing, this high safety factor is a source of satisfaction to boiler plant operators.

Yarway Unit Tandems combine all advancements of modern metallurgy with experienced design and skilled workmanship. The result—DEPENDABLE PROTECTION.

POSITIVE ACTION
...WHEN YOU NEED IT

When putting high pressure boilers on the line, or in times of emergency, you need positive action at the blow-off valves.

With Yarways you have it.

Both the hard seat-seatless combinations and the hard seat-hard seat combinations provide positive opening and closing with drop-tight shut-off. Open yokes permit visual indication of the disc position in the hard seat valve and of the plunger in the seatless valve.

These are some of the reasons why *more than 4 out of every 5 high pressure plants in the United States are Yarway-equipped . . and* among boiler plants of all pressures, *more than 16,000 are Yarway-equipped.*

Write for your free copy of Yarway Blow-Off Valve Bulletin B-425 (pressures to 400 psi) or Bulletin B-433 (pressures to 2500 psi).

YARNALL-WARING COMPANY
109 Mermaid Avenue, Philadelphia 18, Pa.

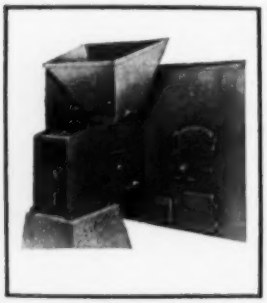
YARWAY®

blow-off valves

new equipment

(Continued from page 18)

the extra gripping power required for operation with grades above 30 degrees. According to the manufacturer, uniform depth of cover pattern provides for longer life.



Underfeed stokers feature hydraulic drive

F27 Unobstructed access to fire doors, sifting doors, and ashpit doors is provided in a single retort underfeed stoker developed by Erie City Iron Works. The unit is hydraulically driven and controlled. A hydraulic fuel feed control offers an infinite range of fuel regulation, and is said to be ideal for automatic combustion control where wide load range operation is desired. Construction is described in a data sheet.

Electrical tape combines many advantages

F28 Teflon tape for electrical insulation is being manufactured by The Polymer Corp. Known as Polypenco, it is said to be unaffected by weather conditions, temperature fluctuations, and exposure to oils and greases. It is chemically inert, and has excellent electrical properties over a wide range of frequencies and temperatures. According to the manufacturer, it will not deteriorate even under continuous service at 482 to 518 F. Because of a high elongation value, it fits tightly over sharp bends and hard-to-insulate surfaces. It is available in thicknesses of .002 to .125 in., and in widths of 1 to 12 in. in ¼ in. graduations.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

Device operates three phase motor on single phase supply

F30 Motor-X Products Co. has developed a motor auxiliary for operating a three phase squirrel cage induction motor from a single phase power supply. It eliminates the need to install three phase transformers, service drops, meters, and wiring, and permits use of three phase motors in areas where three phase power supply is not available. Units are used with wye connected motors. Standard units, available in 1 to 10 hp ratings, operate a 220 v, 60 c motor from a conventional 230 v, 60 c, single phase lighting circuit. Units include branch circuit and motor running overcurrent protection, a disconnecting means, and motor controller.

Bushed sprockets permit immediate delivery

F31 Off-the-shelf availability of roller chain sprockets is an important advantage of Union Jiffy sprockets, according to the manufacturer, The Union Chain & Manufacturing Co. The units employ the Taper-Lock principal, in which a tapered bushing not only is keyed to the shaft, but grips it with the firmness of a shrunk-on fit. Costly and time-consuming reboring to fit shafts is eliminated, and shafts do not have to be turned and ground. No more space is required than with standard sprockets, since there are no flanges or protruding parts. Data are provided in a 4-page folder.

Tube cleaner requires one man to operate

F32 Thomas C. Wilson, Inc. has developed a heat exchanger tube cleaner for use in straight tubes from ½ to 1½ in. OD. The unit, known as model PGX, is a positive drive, high speed hollow rotary shaft, air-driven,

(Continued on page 24)

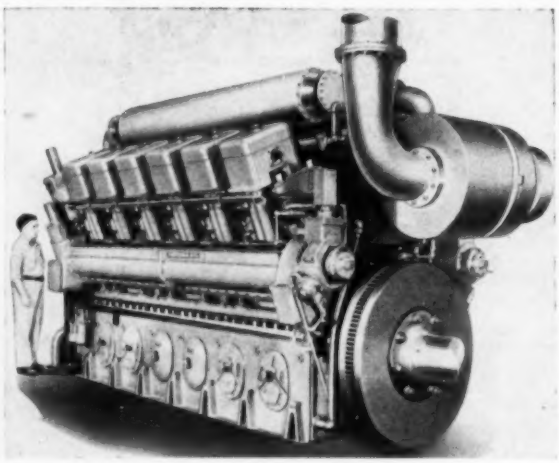
V-type engine features compact size

F29 To meet an increasing demand for heavy duty prime movers of moderate weight and small physical dimensions, Nordberg Manufacturing Co. has developed a V-type, four-cycle engine for operation on liquid fuel, dual fuel, or gas.

As a diesel, the engine burns a wide range of fuel and crude oils. For dual fuel operation, it burns various types of gaseous fuels with a small percentage of pilot oil to control combustion. If gas supply is interrupted, the unit automatically changes to liquid fuel without affecting speed or load. As a gas engine, it will operate on natural gas, butane, propane, manufactured gas, or sewage gas, using a dual spark ignition system.

An unusual feature of the unit, known as Supairthermal, is the simplicity of cylinder construction. Removable cast iron liners seat in individual cast iron jackets. This construction is said to permit directed flow of water for more efficient cooling. The entire cylinder assembly, with liner, is easily removable without disturbing the cylinder liner water seals.

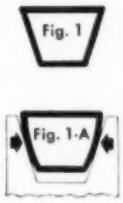
Units are built with 12 or 16 cylinders of 13 in. bore and 16½ in. stroke, covering a range from 2400 to 4260 hp at 450 to 600 rpm. A wide range of models are available to meet both stationary and marine applications.



WHY
Gates V-Belts Wear Longer-

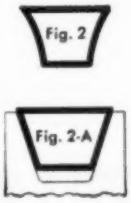
The CONCAVE SIDE (U.S. Patent No. 1813698) is what gives the Extra Wear!

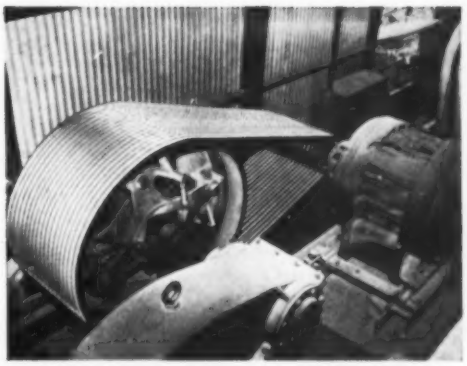
Take any *straight-sided* V-Belt (Fig. 1) and bend it as it bends in going around its pulley. You will clearly see its sides *bulge out* (Fig. 1-A). These sides therefore press *unevenly* against the V-pulley and this causes extra wear at the point shown by arrows (Fig. 1-A).



Now bend a Gates Vulco Rope with CONCAVE SIDES (Fig. 2).

You will see the precisely engineered CONCAVE SIDES fill out to an exact fit in the sheave-groove (Fig. 2-A). The sides press *evenly* against the V-pulley. All wear is distributed *uniformly* across the *full width* of the Gates Vulco Rope—and this means longer belt *life* and *lower* belt *costs* for you.





Typical Gates Vulco Rope Drive—the Gates V-Belts are built with Concave Sides to insure longer belt wear.

When you buy V-Belts, be sure to get the V-Belt with the CONCAVE SIDES—the Gates Vulco Rope!

Gates Engineering Offices and Jobber Stocks are located in all industrial centers of the United States and in 71 foreign countries.

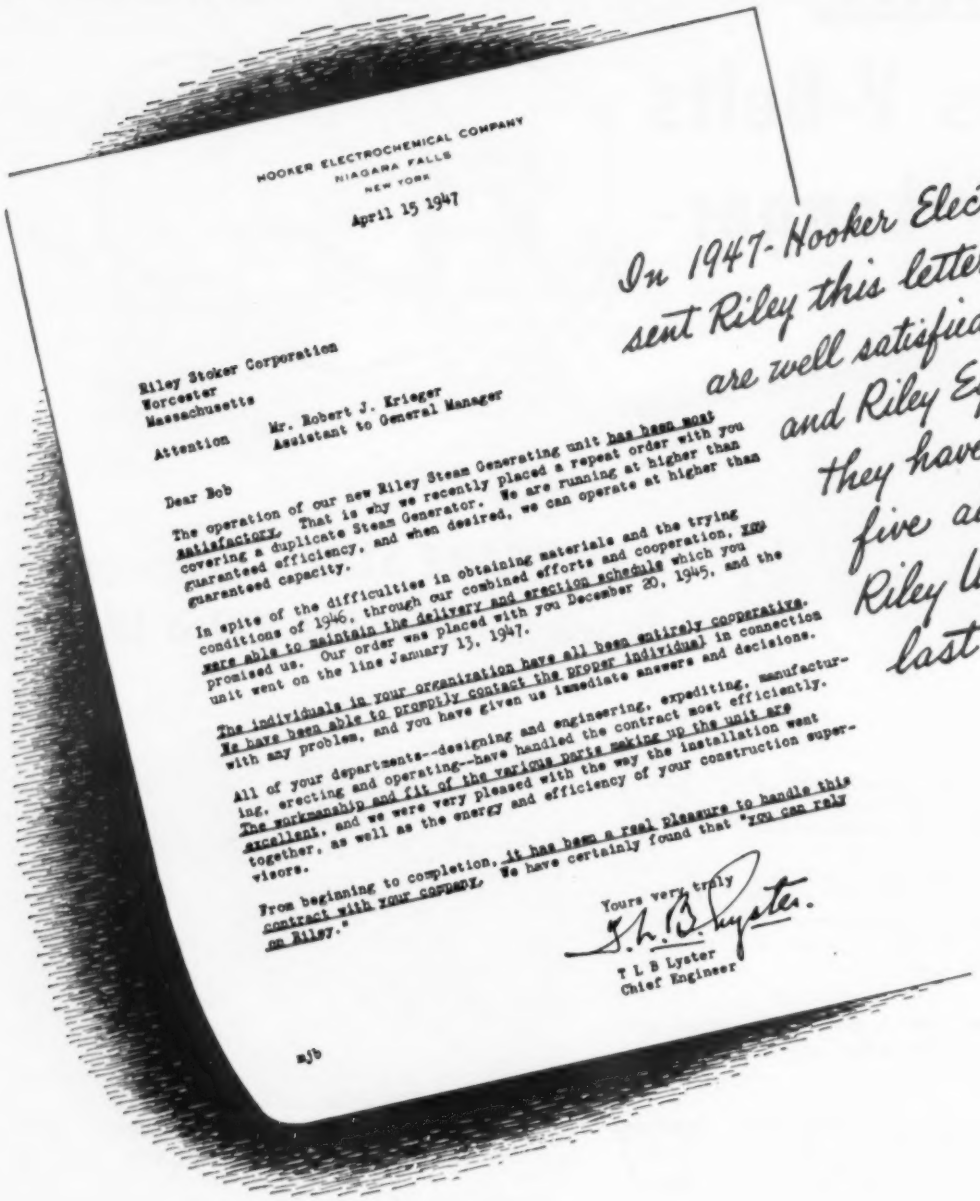
CS-533

V-Belts — Hose
Molded Rubber Goods
for industry
World's Largest Maker of V-Belts

Gates® VULCO ROPE DRIVES

THE GATES RUBBER COMPANY • DENVER, U.S.A.

Since their first unit went on the line in 1947



HOOKER ELECTROCHEMICAL COMPANY
NIAGARA FALLS
NEW YORK

April 15 1947

Riley Stoker Corporation
Worcester
Massachusetts

Attention Mr. Robert J. Krieger
Assistant to General Manager

Dear Bob

The operation of our new Riley Steam Generating unit has been most satisfactory. That is why we recently placed a repeat order with you covering a duplicate Steam Generator. We are running at higher than guaranteed efficiency, and when desired, we can operate at higher than guaranteed capacity.

In spite of the difficulties in obtaining materials and the trying conditions of 1946, through our combined efforts and cooperation, you were able to maintain the delivery and erection schedule which you promised us. Our order was placed with you December 20, 1945, and the unit went on the line January 13, 1947.

The individuals in your organization have all been entirely cooperative. We have been able to promptly contact the proper individual in connection with any problem, and you have given us immediate answers and decisions.

All of your departments--designing and engineering, expediting, manufacturing, erecting and operating--have handled the contract most efficiently. The workmanship and fit of the various parts making up the unit are excellent, and we were very pleased with the way the installation went together, as well as the energy and efficiency of your construction supervisors.

From beginning to completion, it has been a real pleasure to handle this contract with your company. We have certainly found that "you can rely on Riley."

Yours very truly

T L B Lyster
Chief Engineer

mjb

In 1947- Hooker Electrochemical sent Riley this letter. They still are well satisfied with Riley and Riley Equipment- they have ordered five additional Riley Units- the last in 1952.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

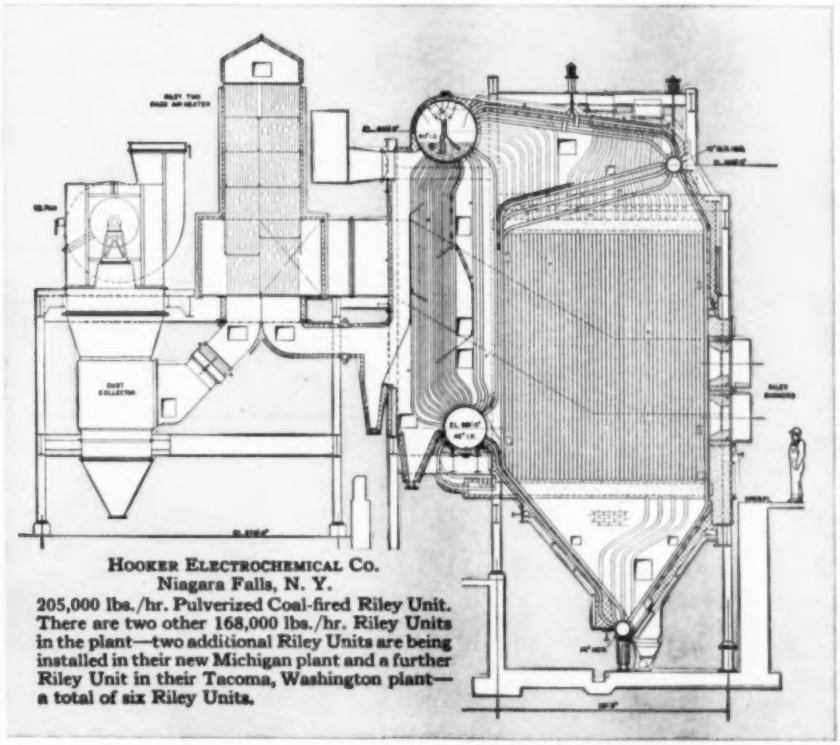
Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Charlotte Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston
Denver Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS

Hooker Electrochemical have ordered five more RILEY Units . . .

RILEY boiler users have with gratifying regularity repeated for more Riley units when installing additional steam-generating units. The accompanying tabulation lists but a few of the companies which have repeatedly placed orders for Riley units. This refusal of Riley users to accept something almost as good tells a significant story of the satisfactory performance of Riley units.

The good engineering and distinctive design characteristics of Riley units assure high operating efficiency, dependable trouble-free operation over long periods with negligible maintenance. Users of Riley equipment know you can rely on Riley. It will also pay you to thoroughly investigate Riley equipment when installing additional boilers.



HOOKER ELECTROCHEMICAL CO.
Niagara Falls, N. Y.
205,000 lbs./hr. Pulverized Coal-fired Riley Unit. There are two other 168,000 lbs./hr. Riley Units in the plant—two additional Riley Units are being installed in their new Michigan plant and a further Riley Unit in their Tacoma, Washington plant—a total of six Riley Units.

This record of repeat orders for Riley Units is sound proof of the dependability of Riley Equipment

CELANESE CORP. OF AMERICA 15 Orders
DOW CHEMICAL COMPANY 13 Orders
CARBIDE & CARBON CHEMICAL 13 Orders
ALLIS CHALMERS MFG. CO. 6 Orders
CENTRAL OHIO LIGHT & POWER CO. 6 Orders
GULF POWER COMPANY 4 Orders
CENTRAL ILLINOIS LIGHT CO. 5 Orders
HOUSTON LIGHT & POWER CO. 9 Orders
ESSO STANDARD OIL CO. 7 Orders
IOWA-ILLINOIS GAS & ELECTRIC 5 Orders
INTERSTATE POWER CO. 5 Orders
KENNECOTT COPPER CO. 6 Orders
MASONITE CORP. 6 Orders
PUBLIC SERVICE CO. OF INDIANA 4 Orders
SHELL OIL COMPANY 7 Orders
U. S. STEEL CO. 10 Orders
SWIFT & COMPANY 10 Orders
STANDARD OIL CO. OF CALIFORNIA 12 Orders
OTTER TAIL POWER CO. 6 Orders
OHIO EDISON CO. 4 Orders
CURTISS-WRIGHT CORP. 7 Orders
PUBLICKER INDUSTRIES 4 Orders
CONTAINER CORP. 4 Orders
BERCHNUT PACKING CO. 4 Orders
GAYLORD CONTAINER CO. 4 Orders
MONSANTO CHEMICAL CO. 4 Orders

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

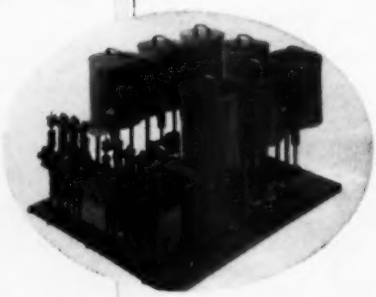
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

UTMOST PROTECTION

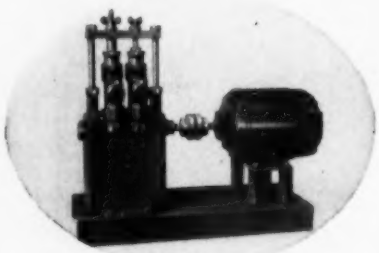
at lowest cost

Manzel CHEMICAL FEEDERS and HYPOCHLORINATORS

To the cost-conscious operators of industrial plants Manzel Feeders pay dividends in accuracy, dependability, and *surprising* economy of purchase and maintenance. Built by an organization famous for fifty years in the manufacture of automatic force feeding equipment, Manzel design is *thoroughly* proven. Whatever your feeding problem, ask Manzel.

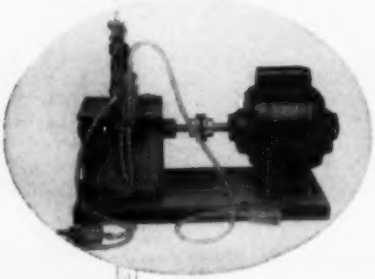


MULTI-FEED CHEMICAL FEEDERS
Any number of pumping units can feed the same or different chemicals simultaneously.



LARGE OR SMALL CAPACITIES
Various models pump from a fraction of a drop to 60 gph. All types of drives are available.

MANZEL HYPOCHLORINATORS
Positive, precise, and *low cost* Easy to install and service.



Look at these Quality Features

- **Full control**... *accurate adjustment from 0 to full feed.*
- **Wide range** *of feed covers nearly every job.*
- **Positive in action**... *no clogging.*
- **Sight Feed** *and solution strainer.*
- **Easily adjusted** *while running.*

Manzel

320 Babcock Street, Buffalo 15, N. Y.

new equipment

(Continued from page 20)

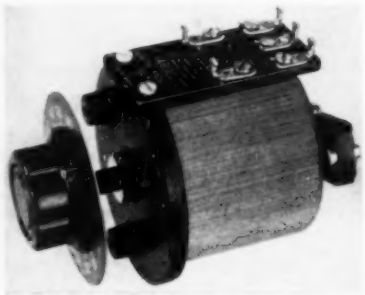
scavenger drill type using carbide tipped bits. It weighs approximately 8 lb, and measures 11 in. over-all. It consumes approximately 70 cfm at 90 psi. Maximum power is derived at 90 psi, operating at about 3500 rpm. It is suitable for both horizontal and vertical applications, and requires only one man to operate. Construction is described in an available bulletin.

Indicating millivoltmeter provides double range

F33 Minneapolis-Honeywell Regulator Co. has developed a single-point, double-range indicating millivoltmeter pyrometer incorporating a newly designed plug-in galvanometer. It is said to be more stable in operation, relatively free from the effects of vibration and temperature, and more easily serviced than earlier types. Two combinations of ranges, 0 to 2400 and 0 to 3000 F, and 0 to 2000 and 0 to 3000 F, are offered as standard. For each combination of ranges, a different galvanometer is supplied. Thermocouples are the detecting element.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.



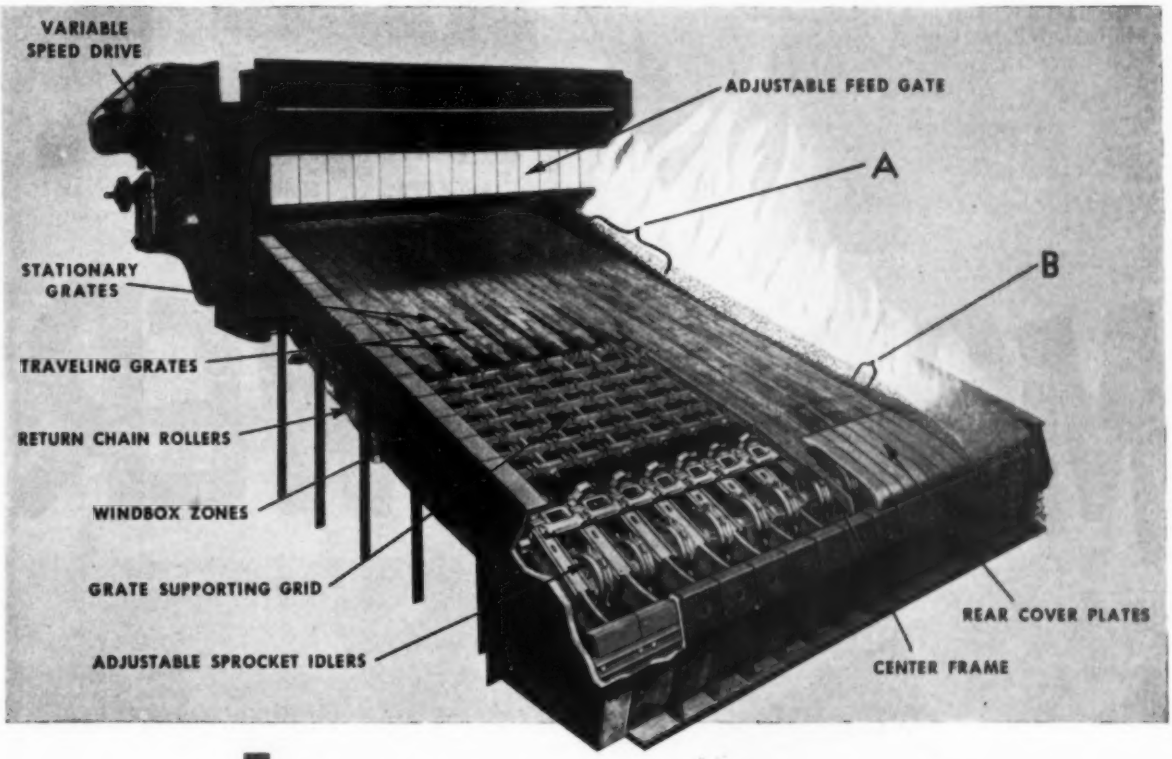
Coating process prevents contact surface deterioration

F34 General Radio Co. has announced the application of a new silver alloy coating process to its Variac autotransformers. This coating, applied to the brush track, prevents contact surface deterioration even when operation at fixed brush settings is carried on continuously. According to the manufacturer, tests indicate that the process makes adjustable autotransformers as durable as a fixed-ratio type.

(Continued on page 28)

STOWE Stoker's

DISTINCTIVE DESIGN

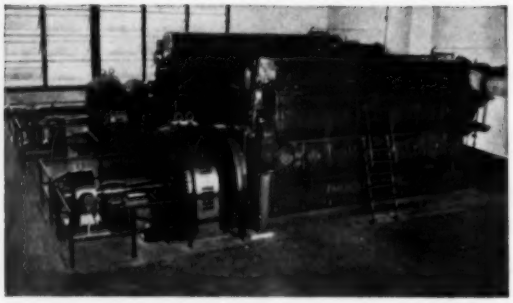


GIVES USERS MANY DISTINCT ADVANTAGES

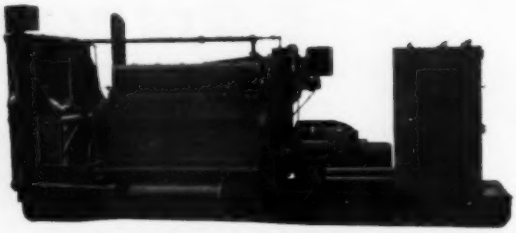
Opposing action of the alternate traveling and stationary grates creates a porous, active fuel bed, packed lightly against the incoming coal. Even depth from side to side, and front to rear simplifies draft problems. Windbox pressure rarely exceeds .75". Coal is burned in the fuel bed not in suspension, avoiding smoke and fly ash. Saves cost of collecting equipment. Travel of fuel bed across the grates diminishes as combustibles burn out. Burning coal occupying space "A" requires only space "B" further on. Ash works to the bottom. No clinker formations. Radiant effect not impaired. Highly efficient at high or low ratings. Burns any bituminous or semi-bituminous coal. Bulletin No. 501 describes performance under various conditions. Send for a copy.

"More Power to You" with STOWE Stokers

Manufactured by THE JOHNSTON & JENNINGS CO. • 6917 Bessemer Avenue • Cleveland 27, Ohio
.... Division of PETTIBONE MULLIKEN CORP...



Two 1000 KW units in a Midwestern Public Utility.



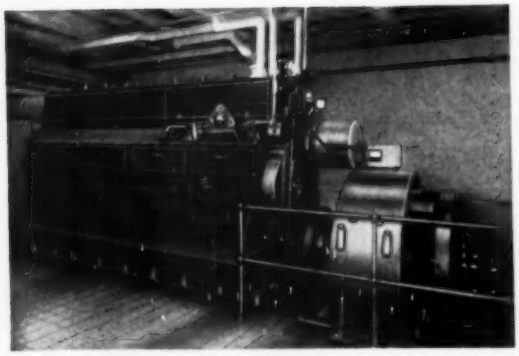
500 KW Package Unit for construction work, standby or emergency power, etc.

MORE POWER

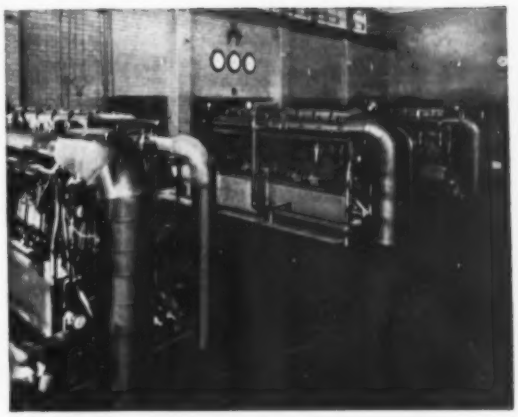
You get tops in power performance and dependability at low operating cost with CP Diesel, Dual Fuel, and Gas Engines. Efficient CP engines are available in sizes capable of delivering from 120 HP to 1750 HP, and in normally aspirated or supercharged models.

Widely used in all types of industries where low cost reliable power is required, CP Diesel Engines are also ideally suited for utilities, institutions, sewage works, and other applications. Write for more detailed information. *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, N. Y.*

to you—at less cost



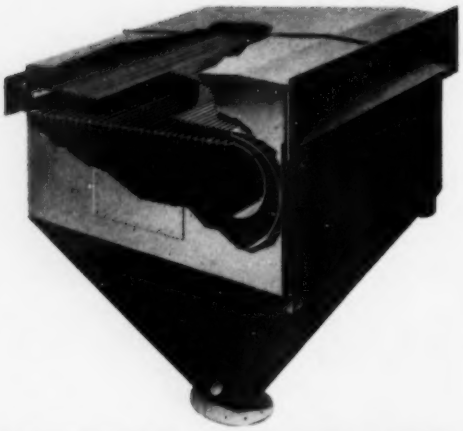
450 KW unit in a New York laundry.



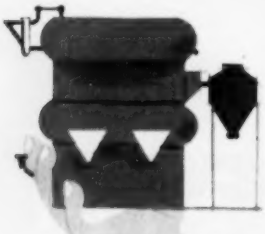
Sewage Gas Engines in a large
Eastern municipal sewage treatment plant.

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES



FLY ASH COLLECTOR FOR SMALL BOILERS?



No Problem!

Works with equal efficiency on natural *and* forced draft installations...gets 99% of all 100-mesh (and larger) cinder discharge.

Eliminates fly ash that would ordinarily seep into production areas...improves working conditions...meets local demands for dust abatement.

Engineered for all modern small boiler plants whether fired by hand, by underfeed, by travelling grate, or by spreader stoker.

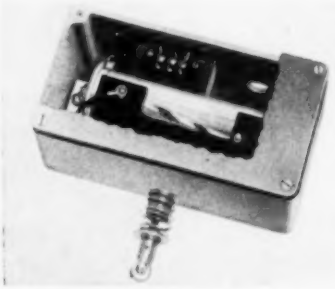
buell ELECTRIC CYCLONIC

Here's *all* the facts. Get your copy today. Write Buell Engineering Company, Dept. 90F, 70 Pine St., New York 5, N. Y.

ENGINEERED EFFICIENCY IN DUST COLLECTION

new equipment

(Continued from page 24)

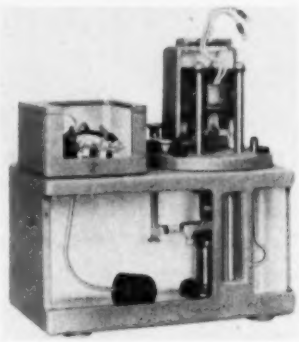


Plunger potentiometer has many applications

F35 Ward Leonard Electric Co. has designed a plunger potentiometer for such industrial electronic control applications as constant cutting speed machine tool drives, winder drives, and processing machinery. In the case of a constant cutting speed drive, the unit interprets the cutting tool's position for the electronic control system. The interpretation can be as a linear or non-linear function. The operating plunger, with its roller-type cam follower, requires only ½ in. linear movement for complete traverse of the 10,000 ohm potentiometer.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.



Lubricating system offers wide control flexibility

F36 Flexibility of control is an important feature of an automatic, metered lubricating system developed by Bijur Lubricating Corp. Designated Type E, it can be applied to almost any type of machine and mounted in any location. It can be actuated by

(Continued on page 33)

For Silica-Free Water at Low Cost . . .

Deionize with AMBERLITE Ion Exchange Resins

AMBERLITE deionization eliminates evaporators, and still gives you highest-quality boiler feed water. Silica, carbon dioxide, and hardness are reduced virtually to zero. Total ionized solids can be kept consistently below 0.1 p.p.m. In addition . . .

1. The initial cost of your water-conditioning system is reduced.
2. Operating costs go down.
3. Maintenance costs you less.
4. You are sure of an adequate supply of conditioned water—despite variations in demand and in the quality of your raw water.
5. Your AMBERLITE unit requires much less space than evaporators.
6. You have a choice of multiple-bed or Monobed (mixed bed) systems.

AMBERLITE and Monobed *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

For more information about AMBERLITE deionization, write Dept. P-2 for complete literature. For bi-monthly reports on new developments in ion exchange, ask to receive AMBER-HI-LITES.

CHEMICALS FOR INDUSTRY

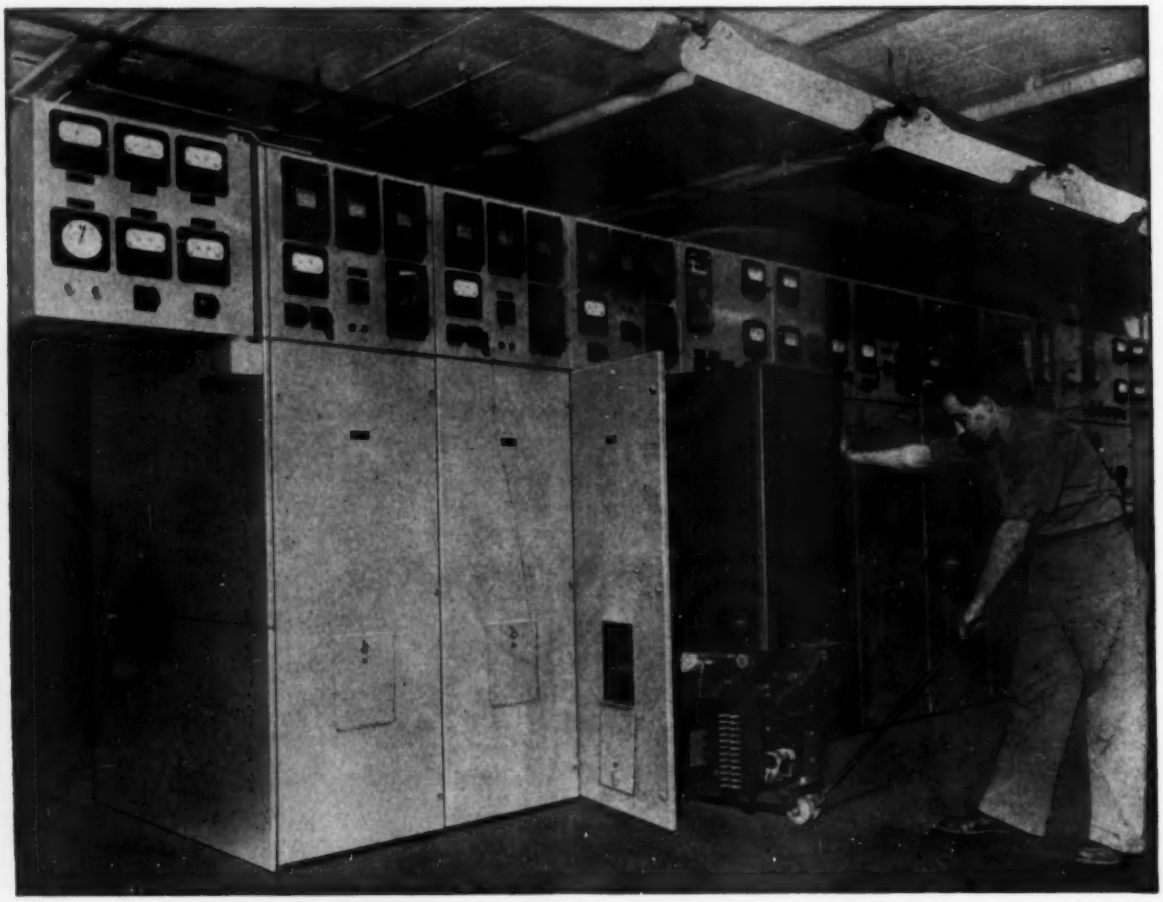
ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

I-T-E Horizontal Drawout Switchgear



I-T-E Metal-Clad Switchboards complement latest engineering advances with neat, modern design. HV circuit breakers are easily withdrawn from compartments. Safety is the keynote.

Indoor and outdoor equipment in ratings: 4160 volts—50,000, 150,000, and 250,000 KVA interrupting—600, 1200, and 2000 amperes continuous

20 years and more of easier handling

Modern switchboards last 20 years or longer. During this period, you can expect periodic inspections, load changes, certain maintenance, and, of course, short circuits and overloads.

Consider the outstanding advantages to yourself of I-T-E *horizontal drawout* switchgear over the life of the equipment in each of the following instances:

When inspections are made

Truck-mounted circuit breakers can be wheeled out of compartments quickly and easily. Safety shutters isolate "live" contacts in the compartment. Connected equipment can then be examined carefully without danger to personnel.

When loads change

Relay settings are quickly adjusted to compensate for load changes. On wider load variations, current transformers may be changed. Isolation of compartments in Metal-Clad construction permits these changes without interference with the main bus. Circuit breakers may be removed from their compartments to assure complete safety. Horizontal drawout circuit breakers in drawout switchboards make this possible and *convenient*.

When maintenance is performed

Each circuit breaker is withdrawn from switchboard, checked, and adjusted if necessary. Service continuity is assured. While the circuit breaker is out of service, a spare can be used to replace it. One spare circuit breaker provides adequate insurance for many feeder circuits.

Your local I-T-E sales engineer will be glad to show you the specific advantages of Horizontal Drawout Switchgear in your own application. Or for complete details on I-T-E Metal-Clad Switchgear, send for Bulletin 7004-B, Dept. IR, I-T-E Circuit Breaker Co., 19th & Hamilton Sts., Philadelphia 30, Pa.

METAL-CLAD SWITCHGEAR

I-T-E CIRCUIT BREAKER COMPANY
19TH AND HAMILTON STREETS • PHILADELPHIA 30, PA.
Equipment Division • Greensburg, Pa.

the pd Decantation Principle

Catches the small ones (flyash) and lets the big ones go . . .

back to the boiler for refiring

Separation of the fines from coarse high carbon flyash for refiring is at last possible in one unit, with no added pressure drop.

Prat-Daniel's Tubular Dust Collector, arranged for Decantation, permits efficient refiring of high carbon dust *without* recirculating the fines!

The P-D two-stage tubular collector is combined in *one* unit yet is no larger in area than a standard P-D Collector. In operation, it requires no additional pressure drop yet assures an extremely high efficiency in the range below 20 microns!

The Thermix Corporation—Project Engineers for Prat-Daniel—will be glad to show you how Decantation saves fuel and eliminates poor combustion resulting from total re-injection.

Ask them for full details on P-D Dust Collectors, Fan Stacks, F.D. and I.D. Fans. P-D Unit Responsibility on these components relieves you of the necessity of integrating equipment from various sources . . . helps make your operation more efficient, less costly. It will pay you to call Thermix today.

Ask for P-D Catalog 4-P201.

Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD., Montreal 25, Quebec; Toronto 5, Ontario

Designers and Manufacturers

PRAT-DANIEL CORPORATION

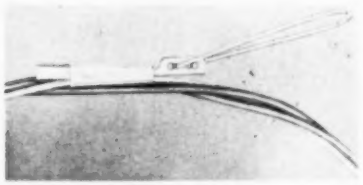
SOUTH NORWALK, CONN.

POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks.

new equipment

(Continued from page 28)

switches tripped by rotary or reciprocating motion, existing control circuits, electric timer controls, or push buttons. It also can be equipped to actuate an alarm when oil supply is low, and to automatically shut off the machine if oil is not replenished. The unit delivers from .2 to .8 cc of oil per stroke. Construction is described in a bulletin.



Clamp simplifies service cable installation

F37 Reliable Electric Co. has developed a service wedge clamp, No. 7080, to permit putting up and sagging of aluminum service cable before cutting. It is said to permit easy attachment of twisted service drop cable to bare neutral at any point in the span. Method of attachment consists of slipping the aluminum shell around the bare neutral and inserting the stainless wedge along steel rails. It grips securely, tightens automatically under load, and does not depend on a screw clamp. It will accommodate all No. 6 and No. 4 sizes, and No. 2 solid.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

Drier efficiently removes moisture

F38 Ansul Chemical Co. announces the development of a desiccant, known as An-Drite, which is said to achieve new standards of efficiency in eliminating moisture from refrigera-

(Continued on page 34)

HOFFMAN VACUUM PUMPS

NEW! VERTICAL MOTOR HIGH ABOVE DIRT AND WATER

If excessively hot condensate is a problem in your steam plant, this New Hoffman Vacuum Pump offers positive relief. The exclusive Jet-Type Vacuum Producer featured in all Hoffman Vacuum Pumps assures efficient operation under conditions ordinarily impossible. It is the most effective means known for simultaneously removing air and water from the system. Years of service cause no deterioration, as the Hoffman Jet has no moving parts to wear or score. As a result, *the Hoffman Vacuum Pump will handle hotter water than other types of pumping units.*

TYPES "VS" and "VSS" SINGLE UNITS
Available in duplex units

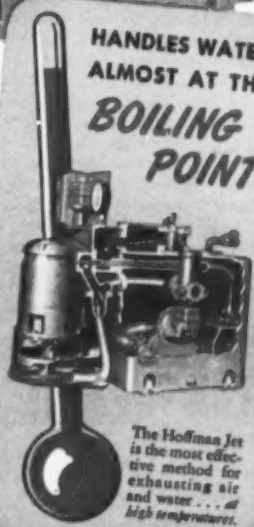
CAPACITIES:
From 2,500 to 100,000 sq. ft. EDR.

DISCHARGE PRESSURES
From 20 lbs. to 60 lbs. per sq. in.

● Bronze fitted throughout ● Enclosed, precision balanced bronze impeller ● Renewable bronze wearing ring ● Split bronze packing gland ● Stainless steel impeller hub ● Impeller has top suction inlet—eliminates air or vapor binding ● Rigid motor support, very quiet ● Easily handles 200°F condensate.

Write today for Cat. No. VP 852, no obligation.

HANDLES WATER ALMOST AT THE BOILING POINT

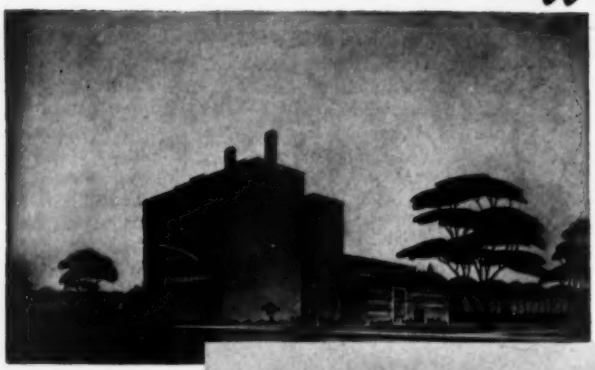


The Hoffman Jet is the most effective method for exhausting air and water . . . at high temperatures.

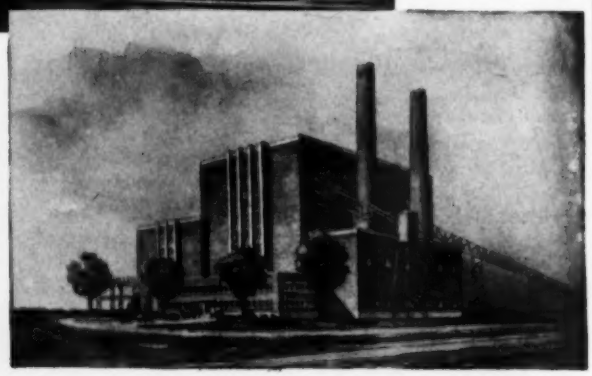
ON THESE TWO INSTALLATIONS

the AEROTEC SERIES

Assures 97.5% FLY ASH COLLECTION *Efficiency*



LEFT: The 264,000 kw (four units) J. Clark Keith Generating Station of The Hydro-Electric Power Commission of Ontario at Windsor, Canada. H. G. Acres & Co., Niagara Falls, Ontario, Consulting Engineers.



RIGHT: The 400,000 kw (four units) Richard L. Hearn Generating Station of The Hydro-Electric Power Commission of Ontario at Toronto, Canada. Stone & Webster Engineering Corp., Boston, Mass., Engineers and Constructors.

Here's on-the-job proof that Aerotec Series Mechanical-Electrical Dust Collectors are used for continuous efficiency. Guaranteed 97.5%, at normal full load the overall efficiency is anticipated as high as 99% at these two Canadian generating stations of The Hydro-Electric Power Commission of Ontario. Aerotec Series Collectors serving each plant combine a design 3RAS Mechanical and an Electrical Precipitator.

In the Mechanical unit, small diameter, permanent molded aluminum tubes provide high efficiency. Exclusive Aerotec pocket type collecting electrodes in the Electrical Precipitator reduce reentrainment of dust in the gas stream, contributing to a sharp improvement in stack appearance. The combined actions of these units assure maximum dust collection efficiency. Many Aerotec Series installations verify that fact.

Your plant can eliminate dust nuisances with Aerotec equipment just as many well-known companies have done. This highly successful performance is a reliable measure of Aerotec ability to solve your dust collection problems. Write our Project Engineers today!

Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONNECTICUT

(Offices in 38 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD.

Montreal 25, Quebec — Toronto 5, Ontario

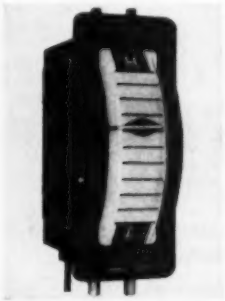
THE AEROTEC CORPORATION

GREENWICH, CONN.

new equipment

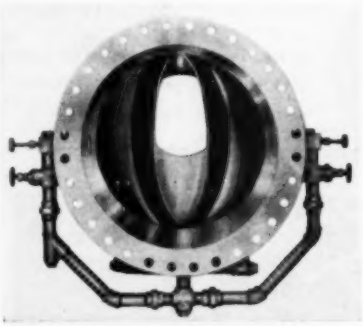
(Continued from page 33)

tion systems, electric transformers, gas lines, and gasoline carburetors. It is being used in the Ansul T-Flo drier. This unit has been designed to provide interchangeability, and is easy to install or replace. It is available in 8, 12, 20, and 30 cu in. sizes. Seven sizes of T-connectors, ranging from ¼ to ⅝ in., are available.



Liquid level indicator provides improved visibility

F39 Easier readings of liquid levels are made possible by a face and cover plate developed by Yarnall-Waring Co. for use on Yarway liquid level indicators. A raised, transparent face permits the indicator arm to be extended under the cover for viewing from the side as well as the front. The improved visibility makes it possible to check boiler water levels from almost any location in the boiler room.



Self-scouring venturi tube

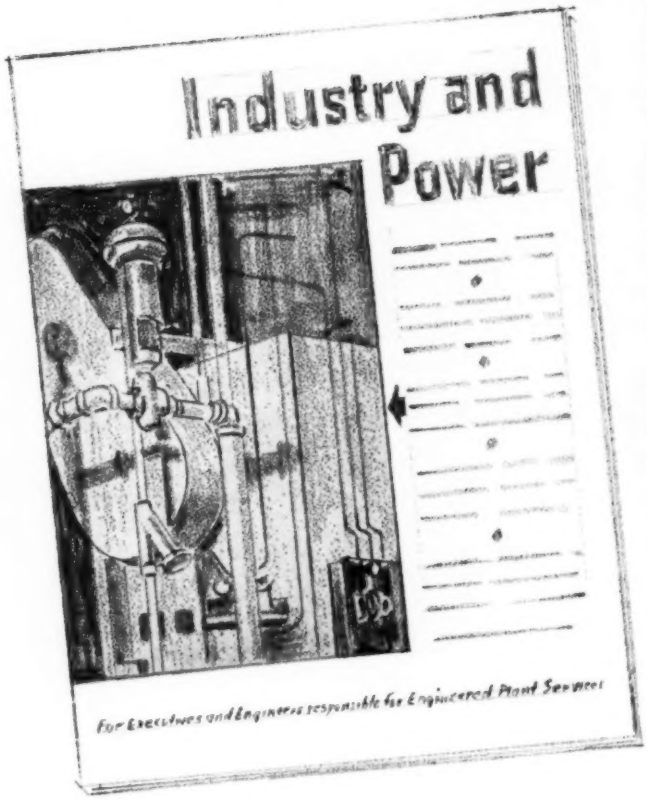
F40 To permit accurate measurement of low-velocity sewage, sludge, and trade wastes under low-pressure conditions, Simplex Valve & Meter Co. has designed a self-scouring Venturi tube with an eliptical throat. It is designated type VE. Major dimension of the eliptical throat is vertical, and equal to the diameter of the circular main section. This permits a straight, flat bottom that is self-scouring of all sediments or solids. Another feature is a straight, flat top which prevents accumulation of air or gas.

—End

$225.00 cash prizes

new name CONTEST

open to all readers of Industry and Power



WIN $100.00 CASH

by suggesting a new name for this magazine

TWO OTHER PRIZES $75 CASH AND $50 CASH

to those submitting the names selected as being second and third best

Why INDUSTRY AND POWER is to be renamed

The present name, INDUSTRY AND POWER, is too general and does not define closely enough the purposes of the magazine, the nature of problems with which it deals, the type of editorial information given, nor the scope of responsibilities of the magazine's readers. Thus, we have decided to look for a name which will be more accurately descriptive of the full range of service to which INDUSTRY AND POWER is dedicated.

READERS OF INDUSTRY AND POWER are the key engineers and executives in plants who are responsible for all the engineered plant services, including:

- Engineered Maintenance
- Materials Handling
- Electrical Distribution
- Steam, Electric and Diesel Power
- Power Distribution and Utilization
- Instrumentation and Controls
- Heating and Air Conditioning
- Industrial Waste Disposal
- Water, Gas & Air Service
- Industrial Lighting
- Engineered Safety and Protection
- Uses of Engineered Services in Production — etc., etc.

EDITORIAL SERVICE to readers of INDUSTRY AND POWER includes articles and information on all of these subjects. Readers are well aware of this breadth of information service provided accurately and thoroughly by the all-engineer editorial staff of this magazine, but the present name falls short of indicating what the magazine does.

KIND OF NAME NEEDED—The magazine needs a name that will indicate its function in dealing with the selection, provision, installation, operation, and maintenance of Engineered Plant Services in industrial plants. It should be a short name, preferably two words, not more than three. It should be a name that is easy to say and, thus, easy to remember.

CONTEST RULES AND OFFICIAL ENTRY BLANK ON OTHER SIDE

(Continued from other side)

RULES governing the naming contest

1. Any reader of INDUSTRY AND POWER is eligible, whether employed by an industrial plant, a manufacturer's sales organization, an advertising agency, or a public utility.
2. Not eligible to compete are employees of INDUSTRY AND POWER or Maujer Publishing Company, nor members of their families.
3. If official entry blank (see bottom of this page) is used, all requested information must be supplied. Entries will be acceptable if submitted on your company letterhead provided you give us the following information:
   a. Typed or legibly printed name of reader submitting the entry
   b. Signature of reader
   c. Name and address of reader's employer
   d. Title or position of reader.
4. An entry may contain two or more *new name* suggestions — as many as you may want to submit.
5. If winning name or either one of the two selected as second and third best is submitted by two or more readers, award in each case will be made to that entry postmarked earliest.
6. Decision of the judges will be final. All entries become the sole property of Maujer Publishing Company.
7. To be eligible, entries must be postmarked not later than July 20, 1953.
8. Address entries to:
   New Name Contest
   Industry and Power
   420 Main Street
   St. Joseph, Michigan
9. New name winners will be announced in the SEPTEMBER issue of INDUSTRY AND POWER, and announcement of when the new name will go into effect will then be made.
10. Judges will be:
    M. J. Sanders, Publisher, Industry and Power
    Hunter R. Hughes, Editor, Industry and Power
    E. R. Gauley, Vice Pres. & Gen. Mgr., Maujer Publishing Company.

NEW NAME CONTEST
INDUSTRY AND POWER
420 MAIN STREET
ST. JOSEPH, MICHIGAN

Date _____

Gentlemen:

Submitted below are my suggestions for new names for INDUSTRY AND POWER:

_____ _____

_____ _____

_____ _____

_____ _____

My name _____ Title _____

My company _____

Company Address _____

City _____ State _____

My signature _____

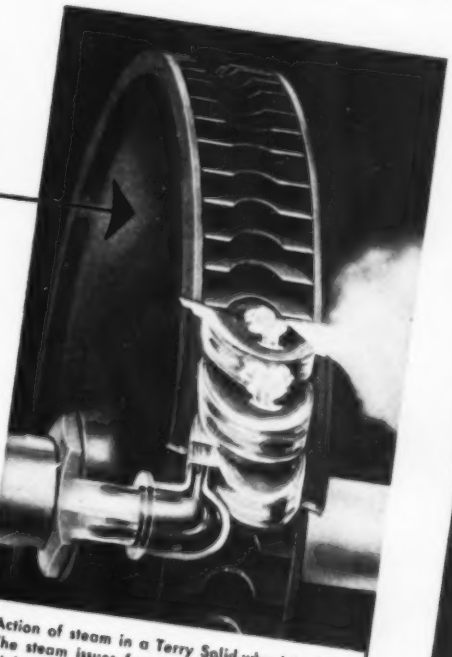
TERRY

THIS TURBINE WHEEL

has no parts to loosen or work out

The rotor of the Terry Solid-wheel Turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to become loose or work out.

The power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Hence, wear of the blades is of little consequence, as it does not materially affect horsepower or efficiency. There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to shaft.



Action of steam in a Terry Solid-wheel Turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

This is only a small part of the story of the many advantages of the Terry Solid-wheel Turbine. Write for complete details.

THE TERRY STEAM TURBINE CO.

TERRY SQUARE, HARTFORD 1, CONN.

TT-1189

Memo

Send for a copy of bulletin S-116 which describes the many advantages of the Terry Solid-wheel Turbine.

24 ACRES *Cover the World*

. . . with TOP QUALITY

DROP FORGED STEEL

VALVES, FITTINGS and FLANGES

by

Vogt

Air View of
Henry Vogt Machine Co.

This 24 acre Vogt plant supplies the most comprehensive line of top quality *drop forged* steel piping materials anywhere available to industry. That's why they're the choice of leading refineries, power plants, chemical plants, etc., the world around!

OUR COMPLETE LINE INCLUDES

Flanged, Screwed and Socket Weld End Globe, Gate and Check Valves • Ells, Tees and Crosses • Couplings • Bushings • Plugs • Unions • Flanges and Flange Unions • Welding Heads

HENRY VOGT MACHINE CO. LOUISVILLE 10, KY.

Branch Offices: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.

OVER 500,000 GALLONS OF WATER are used every day in the Lakeland Company's tannery. This is the de-hairing area, where hides are being treated with a sulphite and lime solution.

THIS COMPACT WORTHINGTON TURBINE PUMP runs 24 hours a day, 7 days a week, assuring a constant, reliable water supply for the tannery.

Worthington vertical turbine pump cuts power costs at Florida tannery

Power costs at the Lakeland Tanning Company in Lakeland, Fla., decreased as soon as a Worthington vertical turbine pump was installed.

Previously, water was supplied by a pump handling 500 gallons per minute, and driven by a 50-hp motor. Every time the pump started up, every other electrical unit in the plant slowed down or dimmed. The smaller Worthington pump furnishes an adequate water supply and uses only a 15-hp motor.

Here's what H. C. Lutes, owner-president of Lakeland, writes about his Worthington:

> "We are well pleased with this pump. It has effected a considerable saving in electricity for us since its installation. No maintenance has been necessary, and this, of course, is a most important factor since our plant would be disabled in case of water failure. To any plant operator desiring trouble-free, dependable service, I would not hesitate to recommend the Worthington."

Reports like this are typical of those received from Worthington users everywhere. Find out how Worthington vertical turbine pumps can save *you* money. Get in touch with your nearest Worthington district office or write to Worthington Corporation, Vertical Turbine Pump Division, at Succasunna, New Jersey, or Denver, Colorado.

D-3-3

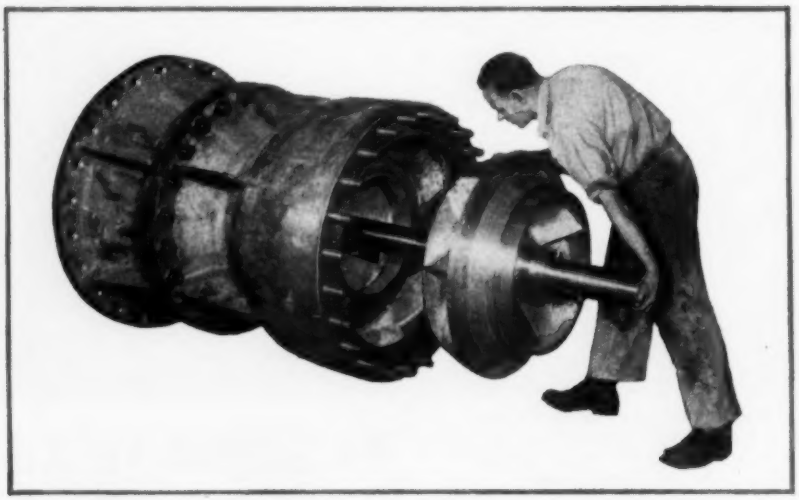
The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON

Vertical Turbine Pumps

CONSERVE GROUND WATER; IT IS A VALUABLE RESOURCE AND IS NOT UNLIMITED

When Erosion, Wear, Fatigue or Corrosion is a problem —try **Monel!**



Let's take a look at a spot where Monel really has a tough job — to handle corrosive salt water!

This vertical salt water pump, and five others like it, pump a total of 144,000 gallons of salt water a minute. The water is used as cooling water in high temperature processing equipment. The pumps were made by PACIFIC PUMPS, INC., Huntington Park, Calif.

If you examined the metal used in one of these pumps, you'd find nearly a ton of corrosion-resisting Monel. Monel is used for the pump shaft and keys where its high strength and fatigue resistance insures a long and trouble-free life. You'll also find Monel discharge elbows, column tubes, oil tube and box, as well as bolts, studs and nuts. Monel-Clad Steel is used for flanges, column pipes and discharges. In fact, practically all surfaces contacting the corrosive salt waters are Monel!

For an interesting booklet on how Monel fights corrosion, write for your copy of "How to Get Longer Service From Your Pumps."

It is advisable to place equipment orders with your supplier well in advance of scheduled use. Distributors of Inco Nickel Alloys can supply the latest information on availability from warehouse and mill. The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

INCO TRADE MARK

Inco Nickel Alloys

MONEL® • "R"® MONEL • "K"® MONEL
"KR"® MONEL • "S"® MONEL
INCONEL® • INCONEL "X"® • INCONEL "W"®
INCOLOY® • NIMONICS® • NICKEL
LOW CARBON NICKEL • DURANICKEL®

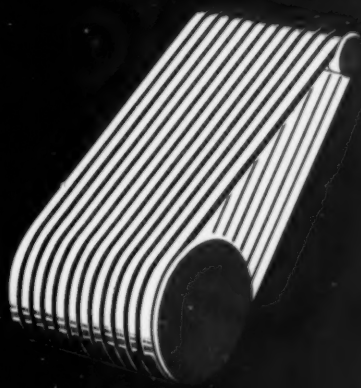
Condor V-Belts–More use per dollar

Condor V-Belts *se per dollar*

Condor V *ollar*

Con *r dollar*

Condor V-Be *per dollar*

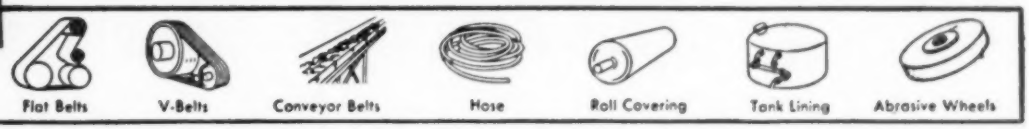


MORE GRIP, LESS SLIP, LONGER LIFE . . . . Yes, you save money with Condor V-Belts on even the toughest multiple belt drive. Straight sidewalls provide more grip, less slip, longer life. They are the smoothest running V-Belts made, because every part is precision-balanced in manufacture. This, too, means longer life. Also in special oil-, heat-, static-resisting types . . . Get the engineering facts. Ask the R/M distributor for Bulletin 6868 . . . He'll tell you, too, how you get MORE USE PER DOLLAR with R/M hose, transmission and conveyor belts.

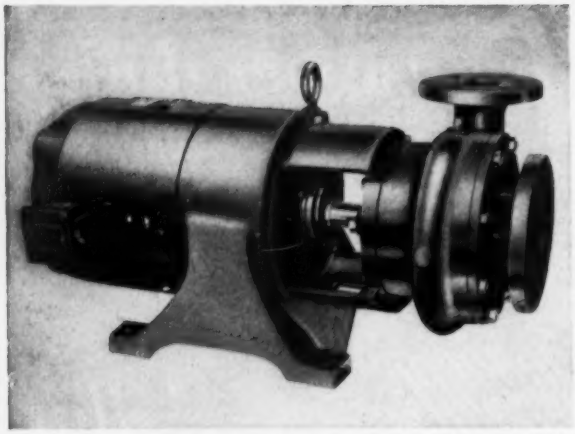
RM

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

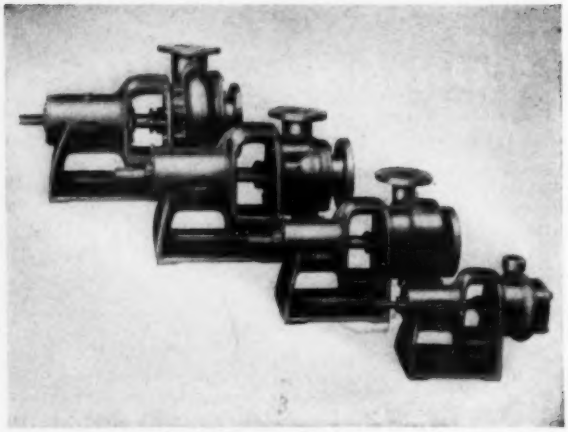
RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

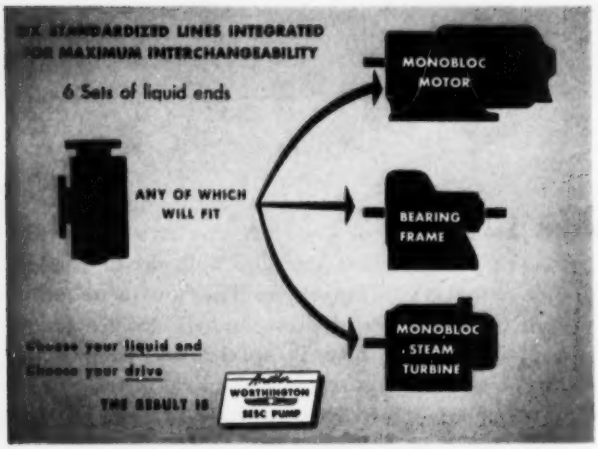


WITH BUILT-IN MOTOR—Well known throughout industry is this compact streamlined Worthington Monobloc centrifugal pump. Worthington SESC standardization makes it possible to interchange any of six sets of liquid ends to the motor housing.



FOR ANY CONVENIENT DRIVE—Frame-mounted units are available in four frame sizes. Like the Monoblocs, they use the same six sets of liquid ends and either conventional packing or a standardized mechanical seal that is readily changed in the field if necessary.

Why Worthington's SESC* pump line means greater availability, broader selection, easier servicing



STANDARDIZATION of *parts, mountings, materials* and *dimensions* virtually eliminates the necessity of slow and expensive custom manufacture to meet special pumping requirements. From 650 parts within its six standardized sets of liquid ends, Worthington can assemble 60,000 *different* standard pumps! C.3.1

Greater availability because the new Worthington pump line will handle more requirements with a *standard*, readily obtainable unit.

Broader selection because of the complete range of ratings and special design features in the 60,000 different SESC pumps.

Easier servicing because standardized parts mean lower parts-inventory requirements.

This sums up the advantages you can expect when you use Worthington standardized centrifugal pumps. The SESC line is Worthington's latest move towards assuring you the *right* pump for the job.

For more information, contact your local Worthington distributor or write for Bulletin W300 B-4 to Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey.

*Standardized End Suction Centrifugal

The World's Broadest Line Assures You The Right Pump For Every Job

WORTHINGTON
Centrifugal Pumps

Air Casualties

It's bad air that does it. But you can step up production by putting a Coppus Blower on the job to keep the air moving — and keep the men cool.

The kind of air a man works in has a lot to do with how much work he can turn out.

In confined places like shipholds or tanks or drums or boilers . . . or wherever the air is stagnant or hot or full of fumes . . . a Coppus Blower is a *must* for getting first-class work out of the men, all the time.

A Coppus Blower or Exhauster helps avoid sickness and lassitude due to bad air . . . and improves morale, too.

Portable and adaptable for special purposes, Coppus Blowers and Exhausters will have dozens of uses around your plant. The "Blue Ribbon" (a blue painted band) is your assurance of quality performance at lowest cost.

COPPUS

BLUE RIBBON BLOWERS

THE BLOWERS THAT PUT MORE MINUTES IN EVERY MAN-HOUR

CABLE MANHOLE AND TANK VENTILATORS — BOILER MANHOLE BLOWERS AND EXHAUSTERS — HEAT KILLERS — SHIPHOLD VENTILATORS . . . DESIGNED FOR YOUR INDUSTRY — ENGINEERED FOR YOU

MAIL THIS COUPON To Coppus Engineering Corp., 186 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other "Blue Ribbon" Products in BEST'S SAFETY DIRECTORY.

PLEASE SEND ME INFORMATION ON SUPPLYING FRESH AIR TO MEN WORKING:

- ☐ in tanks, tank cars, drums, etc.
- ☐ in underground cable manholes.
- ☐ in aeroplane fuslages, wings, etc.
- ☐ on coke ovens.
- ☐ on steam-heated rubber processes.
- ☐ on boiler repair jobs.

COOLING:

- ☐ motors, generators, switchboards.
- ☐ wires and sheets.
- ☐ general man cooling.
- ☐ around cracking stills.
- ☐ exhausting welding fumes.
- ☐ stirring up stagnant air wherever men are working or material is drying.
- ☐ drying of walls, sheets, etc., after treated with coating material.

NAME .....

COMPANY .....

ADDRESS .....

CITY .....

(Write here any special ventilating problem you may have.)

CMH

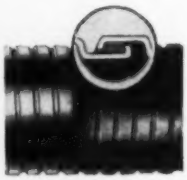
One dependable source for every flexible metal hose requirement

CMH corrugated hose is available with metal braid covering or unbraided in steel, bronze or stainless steel. Used where great flexibility is required at high temperatures and high pressures. Sizes range from 3/16" I.D. to 24" I.D. Depending on size, type and material, it will handle burst pressures to 12,000 psi, temperatures to 1200° F.

CMH interlocked hose is available in various types, packed and unpacked, in steel, stainless steel, bronze, aluminum, brass and other metals. It is used for steam, exhaust, tar and asphalt, etc. Sizes ½" to 12", I.D. Depending on size, type and material, it may be used for working pressures to 750 psi (constant), temperatures to 600° F.

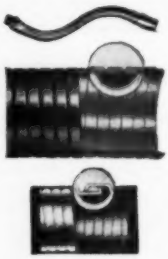
CMH double groove (ball bearing design) hose is available in bronze, steel or stainless steel with asbestos packing and with or without metal braid covering. Widely used for non-searching liquids and gases at low to moderate pressures and temperatures. Sizes range from ½" to 1¼", I.D.

CMH square locked hose is available unpacked or with a choice of several types of packing in steel, bronze, brass, aluminum, stainless steel, etc. It is used as conduit, cable armor, nozzles and many similar applications. Sizes range from ¾" to 1", I.D. Normally used only at very low pressures.



For full information on all CMH hose products write for Catalog 130 or see the Flexonics catalogs in Sweet's Plant Engineering File, Chemical Engineering Catalog and The Refinery Catalog. For maintenance hose, see the classified pages of your telephone directory for the name of your CMH distributor.

Standard assemblies and special purpose flexible metal hose items are manufactured for such services as steam, tar and asphalt, machine tool coolants, machine tool wiring conduit, dry granular products. We will be pleased to send data on any specific requirement.



CHICAGO METAL HOSE Division

Flexonics *Corporation* 1335 South Third Avenue, Maywood, Illinois

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies CMH products that have served industry for over 50 years.

CMH

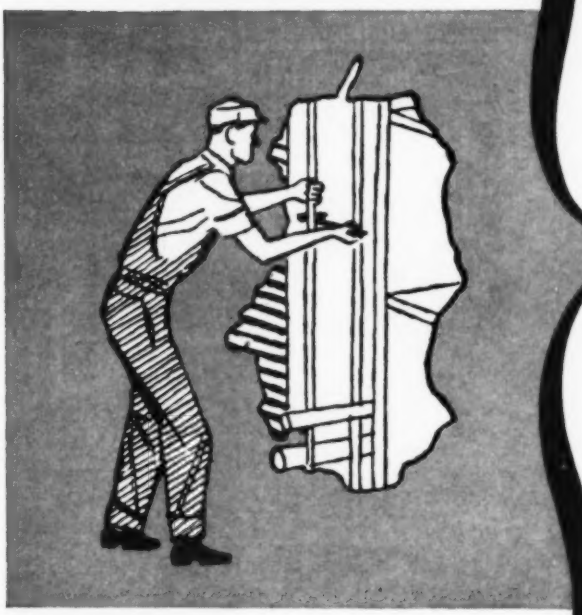
Flexible metal hose

Expansion joints.

Aircraft components

Metallic bellows and bellows assemblies

Pipe Repair Jobs...



	PLUMBER	$2.84 PER HOUR
	MASON	$3.13 PER HOUR
	CARPENTER	$2.63 PER HOUR
	PLASTERER	$3.08 PER HOUR
	PAINTER	$2.57 PER HOUR

add up to just one thing...

CORROSION COSTS YOU MORE THAN WROUGHT IRON

There's nothing like a repair job to point up the false economy of installing low-first-cost piping. The original installation is quickly made by a pipe fitter, but the replacement calls for hours of work by as many as five crafts, all carrying a high price tag. This first failure may wipe out initial savings, a dozen times over. And loss in production or utilization during shutdown may amount to far more than the maintenance charge.

It all adds up to one thing—*corrosion costs you more than wrought iron.*

In literally thousands of applications where corrosion is a threat to service life, the use of Byers Wrought Iron pipe is the soundest kind of economy move. This material's greater durability, proved in past service records, is curbing high maintenance and repair costs in a wide variety of industries.

The next time you approve or specify pipe, investigate the superior performance of Byers Wrought Iron pipe. Remember, it takes only ONE to *install* pipe, but FIVE to *repair* it!

You'll find a lot of helpful information on the control of excessive maintenance in our bulletin, WROUGHT IRON FOR PIPING SYSTEMS. Write for your copy.

Labor costs shown above are estimated national averages according to Bureau of National Affairs, Inc.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

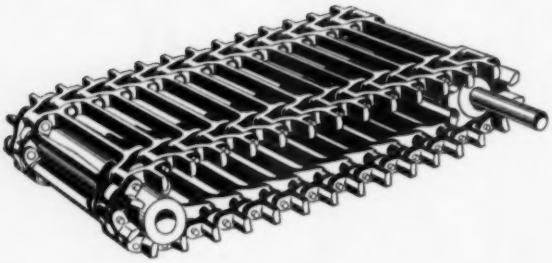
BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS



The secret of no-clog feed for Perfect Spread

PERFECT SPREAD is the only STOKER available today that never clogs... not even on wet coal! And the secret of this remarkable efficiency is the exclusive American Engineering traveling conveyor feeder, pictured above, which employs a high traction principle and assures true, *continuous* feeding throughout its operating range of 50 to 7500 lbs. of coal per hour.

But in addition to no-clog feed, Perfect Spread Stoker gives you every other important feature... the special high-capacity spiral overthrow rotor which spreads coal over the whole grate so perfectly that it furnishes the stoker's name... the engineered cinder return and overfire air system that yield comparable results with both low and high ash coals.

Perfect Spread Stokers are made in a wide choice of sizes, capacities and grate types. Whether you are considering a new unit or restokering an old one, talk things over with your AE representative. It may lead to most steam at least cost.

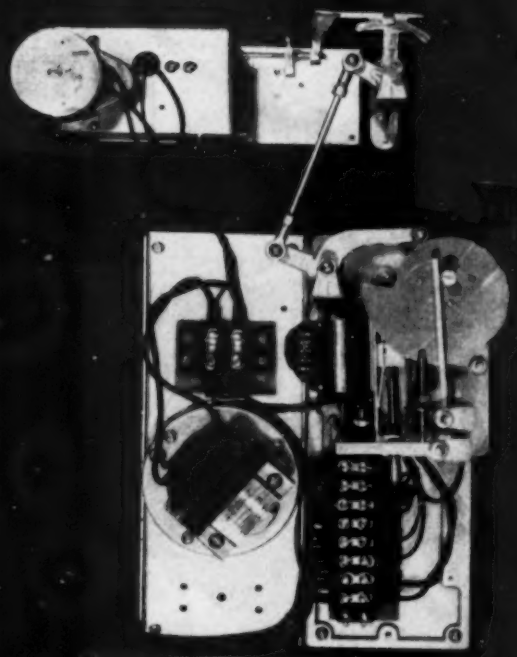
AMERICAN ENGINEERING
COMPANY

2406 ARAMINGO AVE., PHILADELPHIA 25, PA.

IN CANADA: AFFILIATED ENGINEERING CORPORATIONS, LTD., MONTREAL 2, CANADA

AE Products are: Taylor and Perfect spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

a new electronic flow meter!



continuous integration —no creep at zero

unaffected by normal voltage, frequency and temperature changes

electronic operation provides high speed and greater accuracy

3 to 1 range calibration at recorder

HAYS Electronic Flow Meter

Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

Indicators can be calibrated to read directly in rate-of-flow or other factors as desired.

Write today for full information on the Hays Electronic Flow Meter Bulletin 52-1074-222.

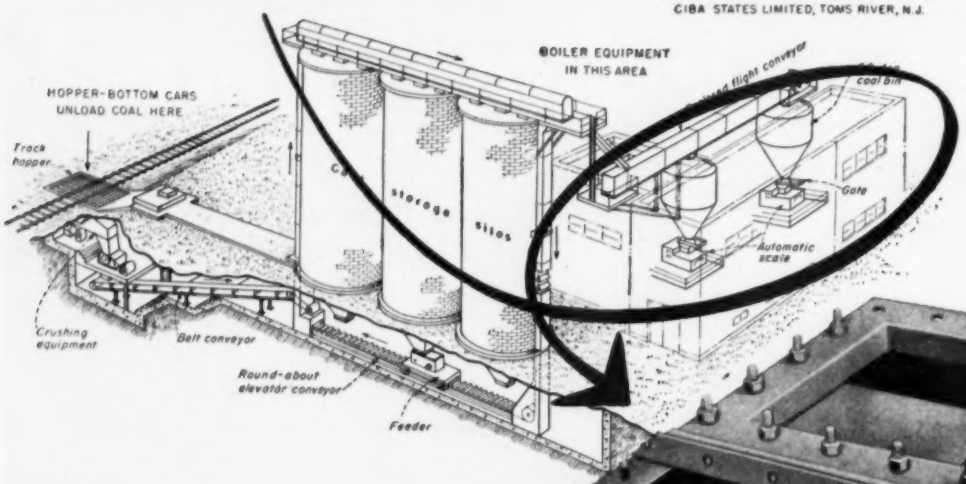
Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Versiflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

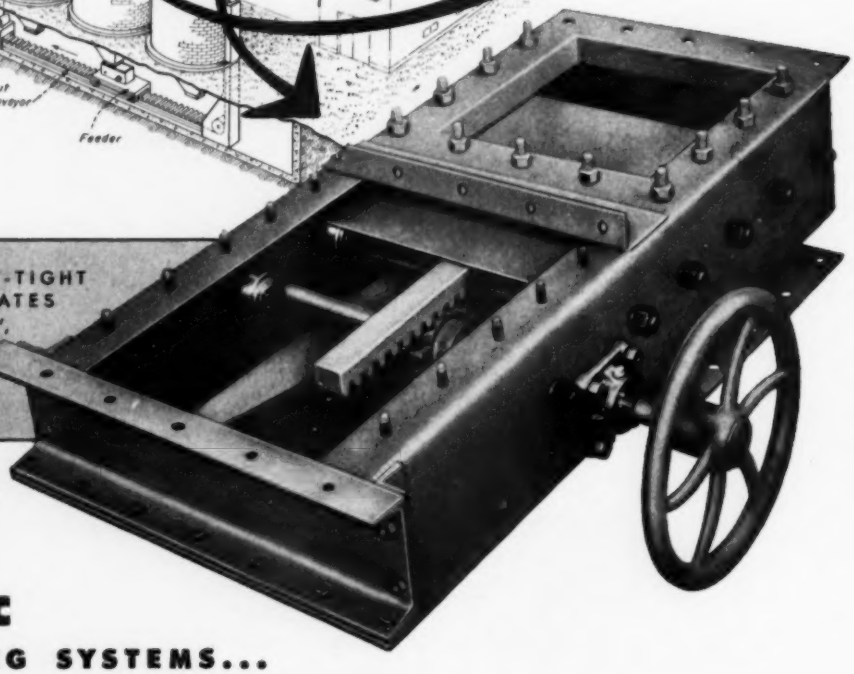
THE hays CORPORATION

MICHIGAN CITY 2, INDIANA

from Receiving Grate ... to Discharge Gate

GIFFORD-WOOD COAL HANDLING SYSTEM AT CIBA STATES LIMITED, TOMS RIVER, N.J.





STANDARD G-W DUST-TIGHT RACK & PINION GATES are available in 3 sizes: 16" x 16", 20" x 20", and 24" x 24". Air-cylinder operation may be specified to replace hand-wheel for special applications.

G-W AUTOMATIC COAL HANDLING SYSTEMS...

engineered for efficiency

This Rack and Pinion Gate is typical of G-W attention to engineering detail. It's the last piece of equipment in the complete G-W Automatic Coal Handling System in the huge new plant of Ciba States Limited, Toms River, N. J.

Through two of these gates pass all the coal used by this large processing plant. They absorb tons of pressure—day in, day out. Yet the rugged all-welded construction of the gate housing gives complete protection to all parts and traps all coal dust. Turning the handwheel moves the slide plate over sturdy roller bearings through a simple rack and pinion mechanism. Simple design?—Yes... but the very efficiency of this gate lies in its *engineered* simplicity... the Gifford-Wood way.

GIFFORD-WOOD CO.

Since 1814
Hudson, New York

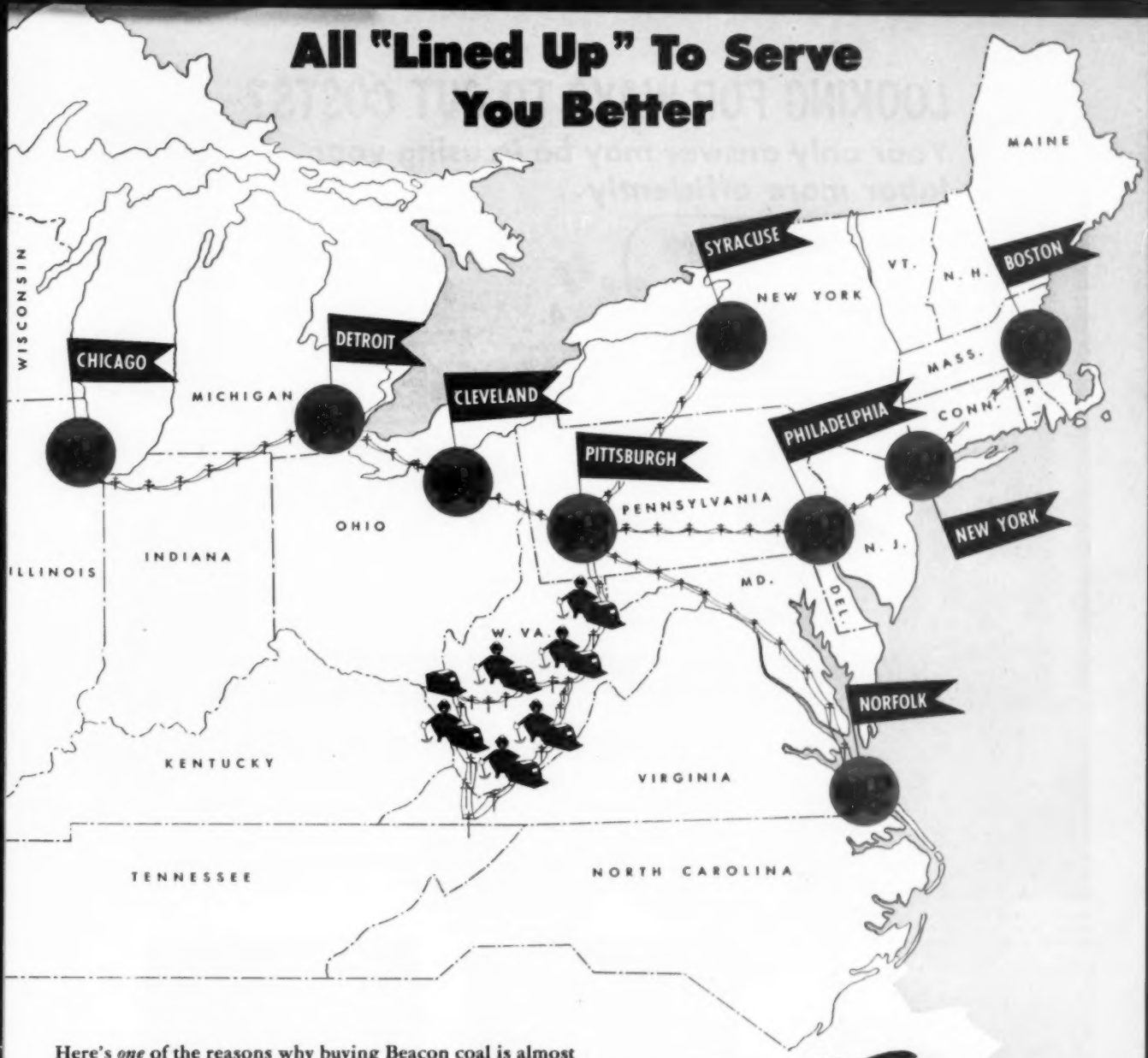
New York 17
420 Lexington Avenue

St. Louis 1
Railway Exchange Building

Chicago 6
565 W. Washington Street

When you think of ENGINEERED Materials Handling... think of Gifford-Wood

All "Lined Up" To Serve You Better



Here's *one* of the reasons why buying Beacon coal is almost like having a mine at your back door, so far as fast, efficient service is concerned.

Most of our mines, and all of our offices, are connected into a wide-spread Teletype network. Inquiries, expediting of orders, and information on shipments are all handled as promptly and completely as a local phone call. You get your answers quickly—and more important, you get your coal when, where and as you want it.

Beacon quality coals are exactly suited to individual applications . . . and Beacon service is exactly suited to your individual needs.

EASTERN GAS AND FUEL ASSOCIATES

EASTERN GAS AND FUEL ASSOCIATES

PITTSBURGH • BOSTON • CHICAGO • CLEVELAND • DETROIT • NEW YORK
NORFOLK • PHILADELPHIA • SYRACUSE

For New England: New England Coal & Coke Co. *For Export:* Castner, Curran & Bullitt, Inc.

LOOKING FOR WAYS TO CUT COSTS?

Your only answer may be in using your labor more efficiently..

1. No More Shoveling, Men Are Free For Other Duties...A Tremendous Saving In Man-Power Alone! Then Consider All The Other Low-Cost Advantages....

2. SIDE DUMP ASH PLATES, AN OPTIONAL FEATURE OF CANTON BINFEEDS, ELIMINATE SMOKE, FUMES, DUST IN BOILER ROOM . . . ASH SPRAY PIPES SIMPLIFY CLEANING.

3. COMPLETE CONTROL PANEL ENGINEERED FOR THE JOB IS WIRED AND TESTED AT THE FACTORY — PAYS FOR ITSELF BY SIMPLIFYING WIRING ON THE JOB SITE AND GUARANTEEING PROPER CONTROL OPERATION. MODULATING COMBUSTION AND DRAFT CONTROLS ARE AVAILABLE ON ALL MODELS.

4. AS AUTOMATIC NOW, AS GAS OR OIL.

5. CANTON BINFEED STOKERS HOLD STEAM PRESSURES CONSTANT, REDUCE FUEL COSTS BY PRODUCING MORE HEAT FROM THE FUEL; ALLOW CHEAPER GRADES AND SIZES OF COAL TO BE USED EFFICIENTLY.

6. NO NEED FOR SEPARATE INCINERATOR WITH CANTON SIDE DUMP BINFEEDS, AS THEY PROVIDE FOR BURNING REFUSE.

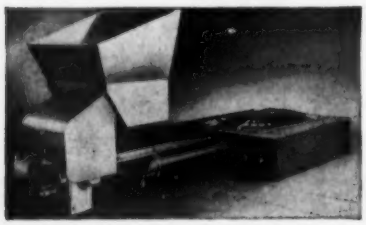
7. FLAT PLATE TOP OF WORM CASING CAN BE INSTALLED AT FLOOR LEVEL, WHEN DESIRABLE, FOR TRUCKS OR TRAFFIC TO PASS OVER.

New Canton Binfeed with coal conveyor rear of boiler. Note fan and automatic draft regulator are also at rear of boiler, out of the way.

LOOK AT THE NEW CANTON STOKER DEVELOPMENTS

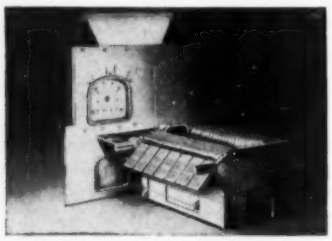
Binfeed Stokers cut costs immediately for every heat and power demand by allowing more efficient use of labor. High wages, going higher, have speeded up the need for automatic handling of coal—the lowest price fuel. It will pay to look into the new developments by Canton Stoker, specialists in COAL FIRING, HANDLING and CONTROL equipment. Representatives in principal cities of the U. S. have complete information, or write direct.

Flo-Tube Coal Conveyors fill one or more hoppers direct from bin or pile. Are also used horizontally as in picture at right, with gate valves to control hopper feeding.



For larger Boilers, ample active burning area is provided by Canton's newest Tuyere design with measured air graduation and fin-cooling ribs. Dead plate type illustrated here . . . also available in side ash dumping type.

Ever see a neater installation? This photo is NOT RETOUCHED. It is Canton Stoker installation, St. Mary's Hospital, Niagara Falls, New York. Hoppers are fed horizontally, direct from bin by screw conveyors.



New Canton "SINGLE-SIDE-DUMP" model, engineered and built for narrow boilers.

"TURBO-AIRE" JETS — for smoke abatement, firing efficiency.

WRITE FOR NEWEST BROCHURE **on Binfeed Stokers. It contains blue-prints and plan of a model stoker installation. A great help in planning or remodeling.**

CANTON STOKERS

CANTON STOKER CORPORATION

403 ANDREW PLACE S. W. CANTON, OHIO

ARE YOUR LINES

"Under the Hammer?"

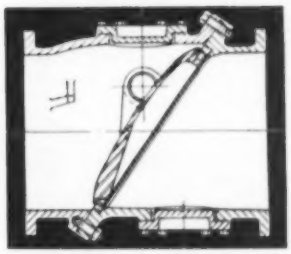
. . . here's how to get them out from under with

CHAPMAN *Tilting Disc* CHECK VALVES

Loosened pipe-joints are caused by hammering. And hammering is caused by valve-slam. But when a valve can't slam under usual piping arrangements . . . then you're free from the danger of line damage.

And this is all because of the Chapman Tilting Disc, with specially designed airfoil section that means light weight, and perfect balance in the open position, so it is easily held open in the flow . . . and then dropped quietly to a *cushioned closing* that does not even jar the line.

That's why certified tests from the country's top engineering schools and actual installations prove that Chapman Tilting Disc Check Valves reduce head-loss over regular swing-type checks. Check these tests for yourself . . . write for Catalog No. 30.

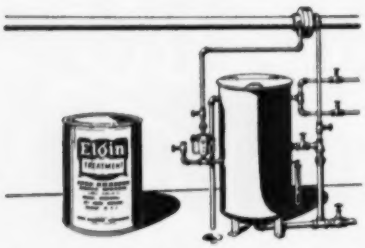


Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

The Chapman Valve Mfg. Co.

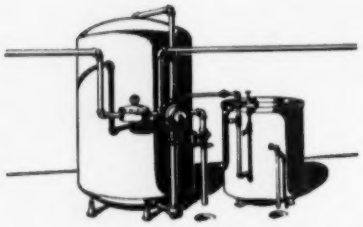
INDIAN ORCHARD, MASSACHUSETTS

Which of these methods will best fit your water conditioning needs?



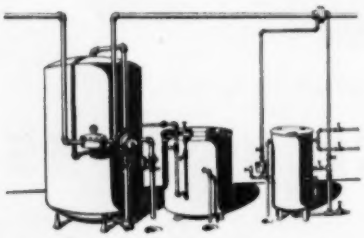
1 CHEMICAL FEED

In many cases, individually prepared Elgin Chemical Treatment alone will effectively prevent scale formation and corrosion.



2 ZEOLITE SOFTENING

A zeolite water softener will efficiently eliminate hardness, scale, and lime deposits.



3 ZEOLITE – POST TREATMENT

A zeolite softener, supplemented by chemical treatment will not only eliminate hardness, but will also prevent corrosion.

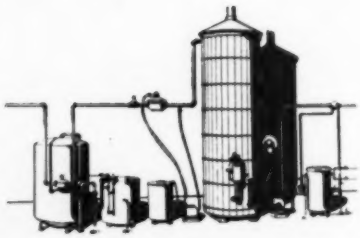
FOR AN UNBIASED ANSWER . . . CALL YOUR ELGIN MAN

Chances are that one of these basic Elgin systems will fit your water conditioning needs. If not, there is no limit to the number of systems we can "tailor" to your exact requirements and budget.

Whether a simple chemical feed system, a zeolite water softener, one of the many ion-exchange combinations, silica and CO_2 removal, or deionization for the highest quality water known today — you may be sure Elgin can provide the type of system required to produce water of the exact characteristics you require.

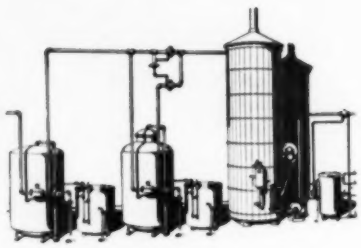
Nearly a half century of water conditioning experience is yours for the asking

Most important is the fact that Elgin's skill and experience, gained through nearly a half century devoted exclusively to the field of water conditioning, is yours for the asking — through our district engineer in your vicinity. Write, wire or phone, and we will put him in touch with you.



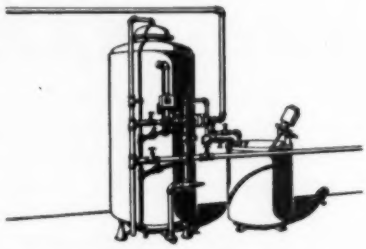
4 ZEOLITE – ALKALINITY NEUTRALIZATION

Water of low-controlled alkalinity, with CO_2 removed, can be produced by acid feed and degasification following zeolite softening.



5 SODIUM – HYDROGEN SOFTENING AND DEGASIFICATION

Blended effluents from a sodium zeolite softener and a hydrogen zeolite softener, followed by degasification, give water in which total solids and alkalinity is reduced and CO_2 is removed.



6 DEIONIZATION INCLUDING SILICA AND CO_2 REMOVAL

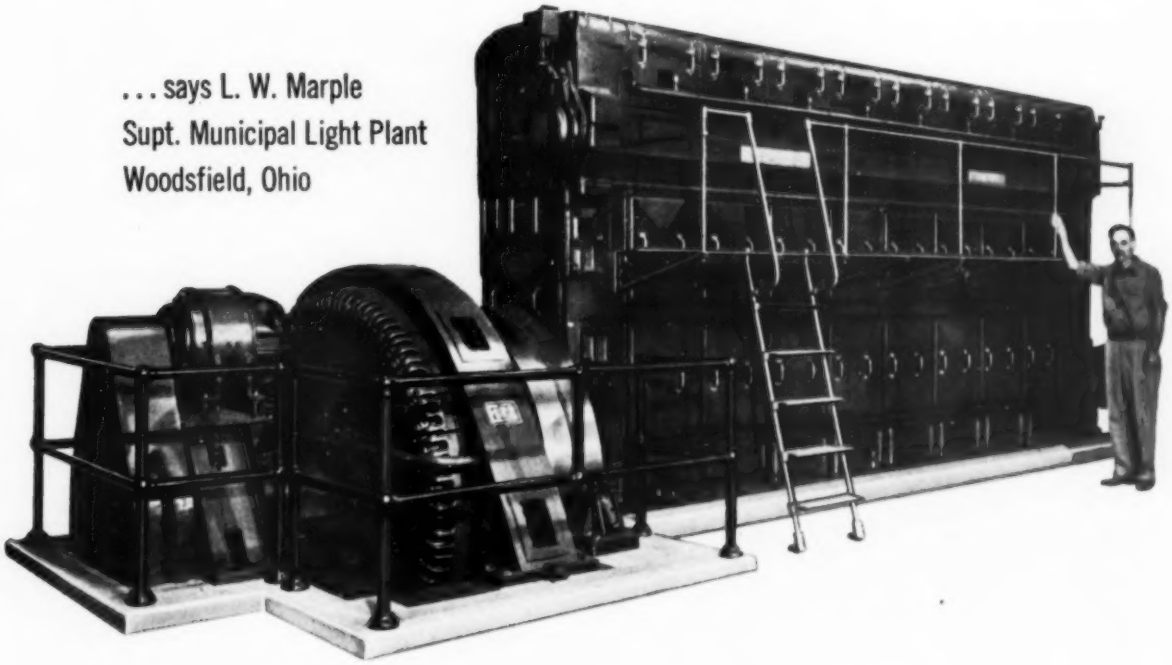
Single-tank Ultra-Deionizer produces the equivalent of distilled water, free from silica and CO_2, at amazingly low cost.

ELGIN
SINCE 1908
WATER CONDITIONING FOR EVERY NEED

ELGIN SOFTENER CORPORATION
138 North Grove Avenue, Elgin, Illinois
REPRESENTATIVES IN PRINCIPAL CITIES

"No More Sticking Rings!"...

... says L. W. Marple
Supt. Municipal Light Plant
Woodsfield, Ohio



● "Because of the lubricating oil we were previously using," says Mr. Marple, "sticking rings and carbon build-up were persistent problems on our three Fairbanks-Morse Model 32-E diesels.

"Three years ago, at the recommendation of one of your lubrication engineers, we switched to Sinclair GASCON® Oil D – HD.

"GASCON D – HD has cleared up our troubles ... no more sticking or broken rings ... no more carbon build-up, even though our load factor has increased. The result is a considerable savings in maintenance costs.

"We are also getting outstanding results with GASCON in our new 875 H.P. National Superior Dual Fuel Engine."

Perhaps a Sinclair Lubrication Engineer can solve *your* lubrication problems. Call your local Sinclair Representative or write to Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR

DIESEL

LUBRICANTS

save wear and replacements

BEATS HEAT...STANDS WEAR... KEEPS STEEL GOING

PENFLEX TUBING PROVIDES FLEXIBILITY ON FUEL LINES... RUGGEDNESS... DURABILITY... RESISTANCE TO HEAT

Connecting fuel and cooling lines on an open hearth take a constant beating. High heats . . . excess wear . . . fatiguing expansion and contraction.

One of the nation's largest steel mills solved the problem with two Penflex products — Penflex interlocked, flexible metal tubing and Penflexweld corrugated tubing, with braided wire covering. "Flexineering" applied the right tubing most efficiently, and more consistent production resulted.

Penflex flexible metal hose with couplings absorbs any pipe movement due to extreme temperatures and pressure changes. Provides outstanding safety and high uninterrupted flow of flammable materials. Leakproof, tough and flexible.

Penflex engineers can help you solve flexible tubing application problems. Penflex manufactures a complete line of four-wall, interlocking and seamless welded corrugated tubing . . . from ⅛" I. D. and up . . . automatic barrel fillers, accessories and fittings.

Write for this helpful folder, "Flexineering" ...your guide for solving tubing problems.

Pennsylvania Flexible Metallic Tubing Company, Inc., 7238 Powers Lane, Phila. 42, Pa.
Branch Sales Offices: **Boston • New York • Chicago • Houston • Cleveland • Los Angeles**

PENFLEX

HEART OF INDUSTRY'S LIFE LINES

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

COMPACT CAPACITOR INSTALLATION in the Halle Bros. Company, Shaker Square store, Cleveland, Ohio, is inspected by Mr. W. L. Smith, store engineer

Saves $800 a year on a $620 capacitor investment

Halle Bros. Co. cuts power costs 19% improves power factor 20% with G-E capacitors

An installation of General Electric capacitors produced these results in the Shaker Square Branch store of Halle Bros. Company, Cleveland, Ohio, according to Milton Beyer, Building Superintendent.

Serious power losses were encountered prior to installing capacitors because of low power factor air-conditioning motor loads. In addition, a kva-demand clause in their power contract was penalizing the Company for poor power factor.

SAVINGS EFFECTED. Since installing G-E capacitors, there has been a reduction of from 18% to 20% in the total power bill. Power factor has been increased more than 20%, from 71.6% to better than 95%.

CAPACITORS PAID FOR IN 6 MONTHS. In the first six months, the capacitors saved the Halle Bros. Company more than $600. Since the total installed cost of the G-E capacitor equipment was only $620, it paid for itself in less than a year. But the savings won't stop here. As superintendent Milton Beyer puts it, "We expect to save about $800 a year from now on."

KEY TO LOWER POWER COSTS. If your power factor is below 90% and if there is a kva-demand or power-factor clause in your power contract, chances are you, too, can make worthwhile savings on your power costs by installing G-E capacitors. For additional information, consult your nearest G-E Apparatus Sales Office, or authorized agent or distributor. Or write to Section 441-102 for Booklet GEA-5632—"How to Use Capacitors to Reduce Power Costs." General Electric Company, Schenectady 5, New York. 441-102

You can put your confidence in—

GENERAL ELECTRIC

MICRO-KLEAN FILTER HALVES CARTRIDGE REPLACEMENT COSTS

Resin Impregnated Fibre Cartridge Lasts Twice as Long

MICRO-KLEAN's graduated density-in-depth allows greater capacity for dirt accumulation within the micronic cartridge, giving twice the effective life of an ordinary filter cartridge. Thus, cartridge replacement costs are cut in half. And the high porosity of MICRO-KLEAN permits higher flow rates, enabling you to speed up fluid processing.

Each fibre of the MICRO-KLEAN filter is positively bonded in position by resin impregnation and polymerization. This provides great structural strength and complete protection against channeling, rupturing, shrinking or distortion.

Cuno's exclusive method of felting fibres permits precision control of the cartridge structure, assuring MICRO-KLEAN users of consistent, uniform filtration.

MICRO-KLEAN's low pressure drop operation permits full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

Try a MICRO-KLEAN cartridge in your replaceable-element type filter. Standard sizes fit many types of industrial filters now in use. Special lengths of MICRO-KLEAN cartridges can be supplied for built-in installations. MICRO-KLEAN cartridges also come in a wide range of Cuno housings.

Take advantage of Cuno's unique "money-back" offer: if MICRO-KLEAN doesn't outperform any filter cartridge you have previously used, we'll send you *double* your money back. Send coupon today for MICRO-KLEAN bulletin.

M.3.1

Cuno Engineering Corporation
Dept. 141C South Vine Street, Meriden, Conn.

I'm interested in your "money-back" offer.
Please send me bulletin on Cuno MICRO-KLEAN.

Name.....

Company.....

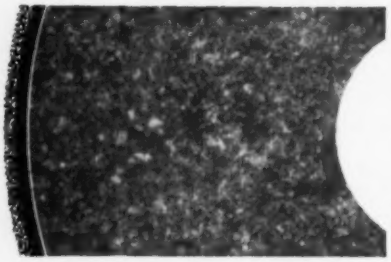
Address.....

City.....Zone....State.....

GRADUATED DENSITY

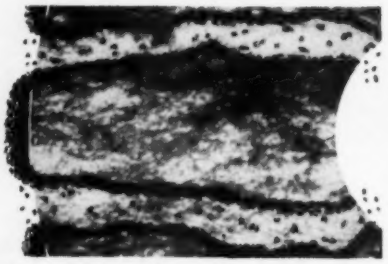
makes MICRO-KLEAN the most effective filter on the market!

How MICRO-KLEAN compares with other cartridge filters



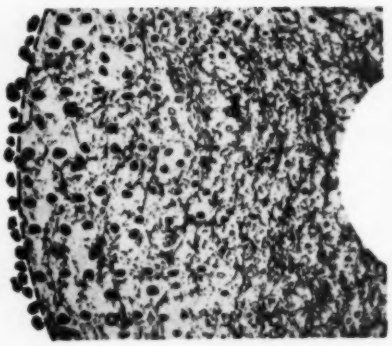
***Compare* MICRO-KLEAN with**

FILTERS WITH THE SAME DENSITY THROUGHOUT. The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



***Compare* MICRO-KLEAN with**

FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA. Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



***Now Look* at the advantages offered by MICRO-KLEAN.** See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN's graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2¾" O. D., in densities of 10, 25 and 50 microns.

MICRO-KLEAN gives you

- **greater dirt holding capacity**
- **absolute protection against rupturing or channeling of the cartridge**
- **longer effective cartridge life**

REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT

M.3.C

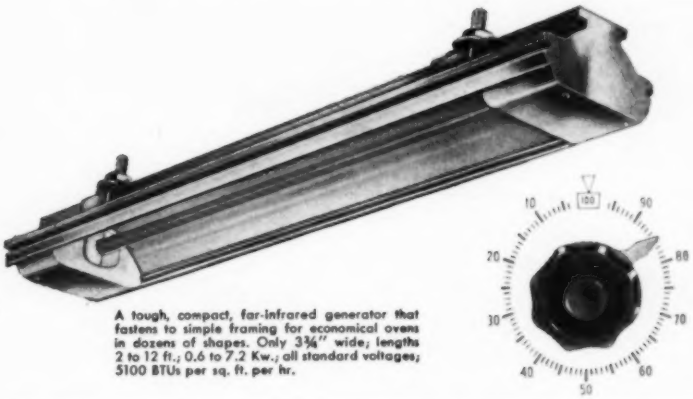
CUNO

ENGINEERED FILTRATION

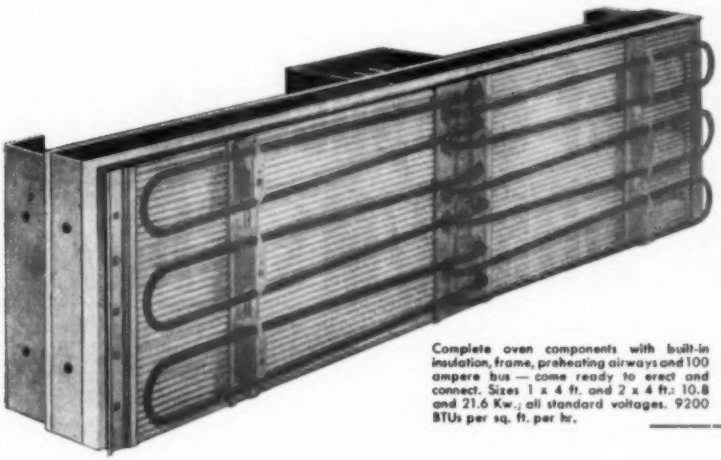
Removes More Sizes of Solids From More Kinds of Fluids

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

uniform heat . . .
precise heat . . .
fast heat . . .
"**color blind**" heat . . .



A tough, compact, far-infrared generator that fastens to simple framing for economical ovens in dozens of shapes. Only 3¾" wide; lengths 2 to 12 ft.; 0.6 to 7.2 Kw.; all standard voltages; 5100 BTUs per sq. ft. per hr.



Complete oven components with built-in insulation, frame, preheating airways and 100 ampere bus — come ready to erect and connect. Sizes 1 x 4 ft. and 2 x 4 ft.: 10.8 and 21.6 Kw.; all standard voltages. 9200 BTUs per sq. ft. per hr.

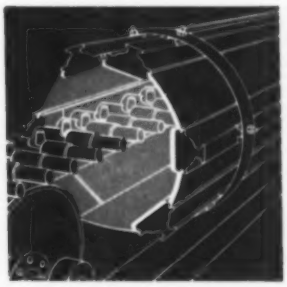
A Chromalox Electric Radiant Panel or Chromalox Radiant Heater installation gives you a quick, low-cost answer to your baking, curing, drying and other heating needs. Pre-engineered units allow on-the-spot erection and connection. You get up to 700° F. work temperatures; absolutely uniform radiation with no hot and cold spots; high intensity heat that's absorbed *f-a-s-t* by all colors; and accurate "dialed" heat from 0 to 100% of capacity.

CHROMALOX *Electric*

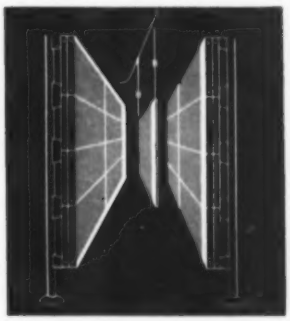
Far-infrared Units

TWO JOB-PROVED FAR-INFRARED TYPES TO CHOOSE FROM!

You'll find Chromalox pre-built Radiant Panels and Heaters from stock fit your jobs and your budget. Shown below are just two of the literally hundreds of oven shapes and sizes which can be erected quickly and easily using Chromalox Electric Radiant Units.



Conveyorized oven built on the job using Chromalox Radiant Heaters. Units are installed in lengths and ratings needed to fit the work. Input controller gives precise and exact temperatures easily adjusted to meet varied processing requirements. Easy to assemble, easy to wire.



Chromalox pre-engineered Radiant Panels are easily and quickly erected and connected to form ovens and drying tunnels of any size and shape. An oven such as sketched may be installed in 20 to 30 man-hours with minimum engineering expense and lowest cost per installed kilowatt.

Have a Problem Involving Degreasing, Drying, Baking, Preheating, Curing?

The assistance of Chromalox Application Engineers is yours for the asking. They'll help you work out your specific requirements without obligation. Write today.

EDWIN L. WIEGAND CO. IC-70
7520 Thomas Blvd., Pittsburgh 8, Pa.

I'm interested in electric heat for.....
.....
.....

☐ Send me Bulletins on Far-infrared units.
☐ Have a Chromalox Application Engineer get in touch with me.

Name.....
Company.....
Street.....
City.....Zone.....
State.....

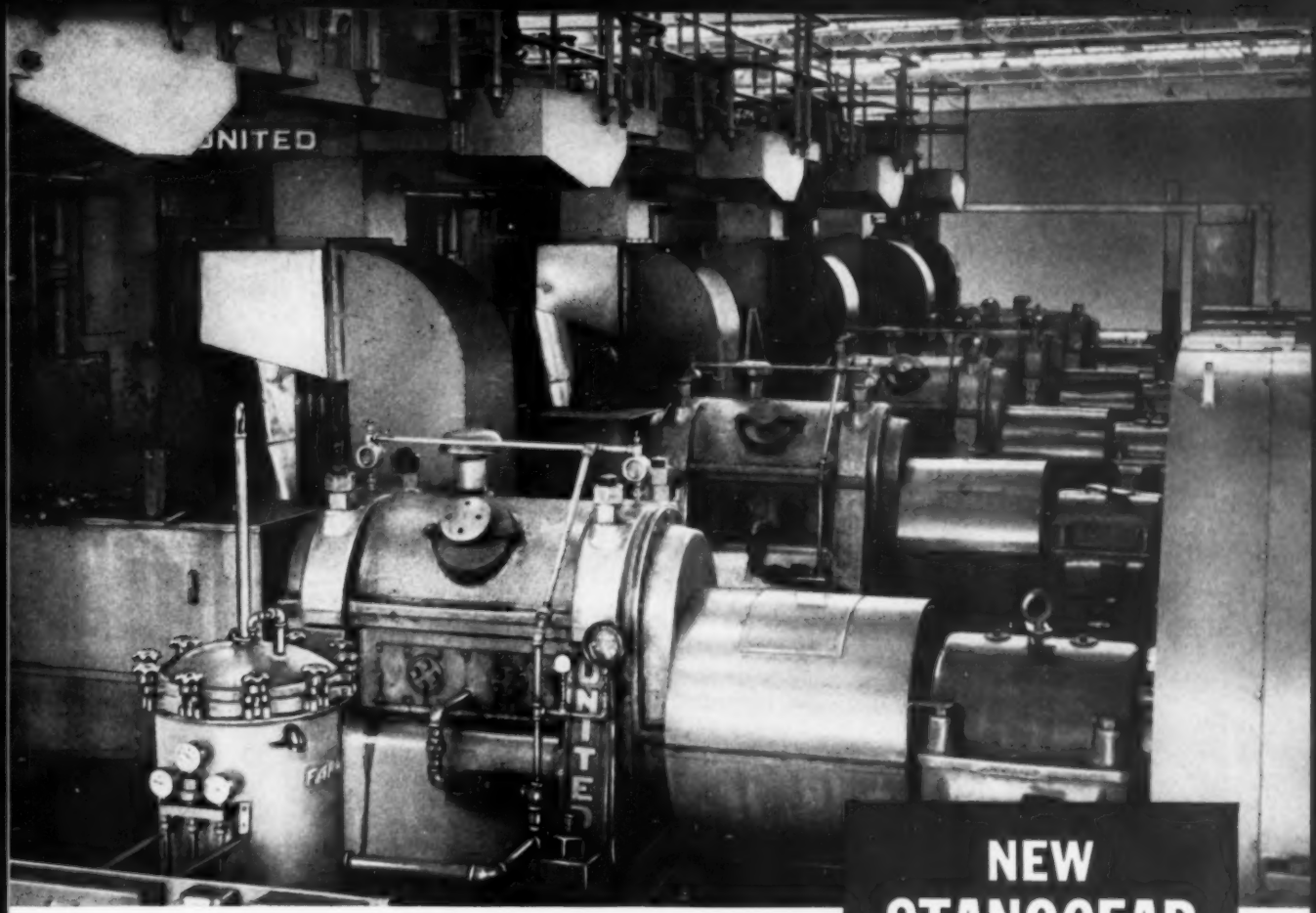
NOW! 95% of all packing needs are met with R/M's BIG 7

Lower inventories! Simplified ordering! Reduced downtime! These are the advantages you get with the "Big 7" R/M Packing Types. This basic line of field-tested packings is engineered to give custom-built performance in all but the rarest packing applications. *Just three or four* of these seven types will very likely take care of the entire needs of your plant. Bringing you this simplified approach to the packing problem drew on R/M's 50 years of know-how and experience, and all the research, testing and production facilities of its seven great plants. Ask your distributor to show you how you can benefit by standardizing on R/M's "Big 7."

R M **PACKINGS**
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Neenah, Wis.; Peterborough, Ontario.

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Teflon Products • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls



NEW STANOGEAR
REG. U. S. PAT. OFF.
Compounds

NOW . . . 7 ways better for extreme-pressure lubrication . . .

New and improved STANOGEAR Compounds have been developed to meet the requirements of an increasing variety of tougher extreme-pressure lubricating jobs found throughout industry, today. The result of several years of special research and field test work, these outstanding products have proved in actual service their ability to provide these important advantages:

1. Higher load carrying capacity. Use of improved extreme-pressure additives in STANOGEAR Compounds provide a greater anti-weld property. This results in the higher load carrying capacity which these products have demonstrated in actual service.

2. Superior retention of load carrying capacity. In service tests, STANOGEAR Compounds have proved superior to conventional extreme-pressure lubricants in ability to maintain a high load carrying capacity over extended periods of service.

3. Freedom from objectionable deposits. Appropriate base stocks and additives give STANOGEAR Compounds a high resistance to oxidation, thus minimize the formation of deposits.

4. Excellent storage stability. STANOGEAR Compounds contain compounding ingredients which assure excellent stability both in service and storage.

5. Good water separation. STANOGEAR Compounds have demonstrated their superiority to ordinary extreme-pressure lubricants in ability to provide good water separation.

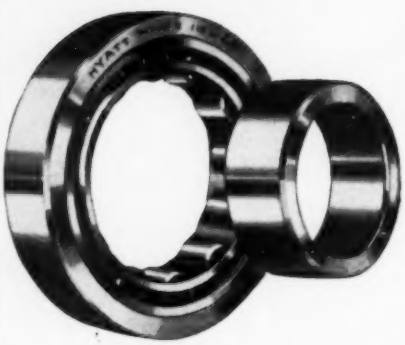
6. Anti-foaming. Under adverse operating conditions, the anti-foam agent in STANOGEAR Compounds has prevented foaming troubles.

7. Versatility. A unique combination of additives in STANOGEAR Compounds equips these products for various industrial gear applications where extreme-pressure lubricating properties are necessary. To meet varying viscosity requirements, STANOGEAR Compounds are available in eight viscosity grades.

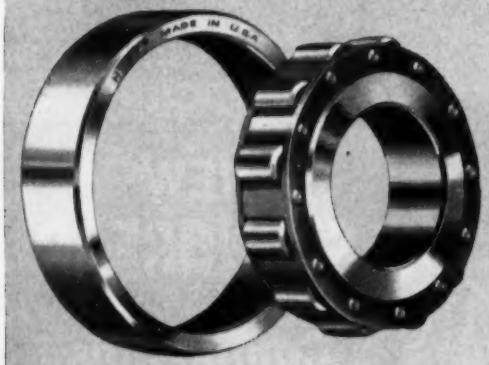
The Standard lubrication specialist in your area of the Midwest will be glad to give you more information about the new STANOGEAR Compounds. You need only phone your local Standard Oil office. Or write: Standard Oil Co., 910 South Michigan Avenue, Chicago 80, Illinois

STANDARD OIL COMPANY STANDARD *(Indiana)*

3 ways to handle your RADIAL LOAD PROBLEM

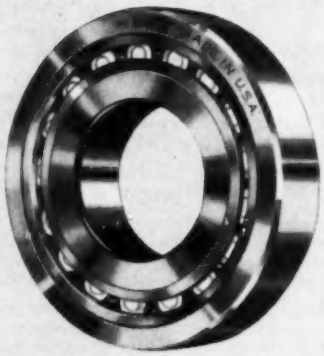


1 If your design requires a large shaft diameter to produce greater rigidity without disturbing boundary dimensions, a separable inner race type Hyatt Hy-Load bearing can be used with the inner race omitted. Rollers operate directly on a suitable hardened and ground shaft.



2 When the housing bore must be kept to a minimum, a Hyatt Hy-Load bearing with a separable outer race can be used—with the outer race omitted. The rollers then operate directly in a housing bore of suitable hardness and finish.

If your design applications involve radial loads, the best way to handle the job is with Hyatts—for Hyatt offers industry's most complete line of straight radial roller bearings! Hyatt Hy-Loads, for example, are made in three diameter series and two basic widths, to standard dimensions. There are ten major types—for the heaviest radial loads, and light or intermittent thrust loads. Four have separable inner races, two have separable outer races and four are non-separable, thus permitting wide flexibility in design and assembly procedures. Write for our general catalog No. 150—it will put the solution to any roller bearing problem at your fingertips. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.



3 For designs requiring a bearing installed as a unit, there is the non-separable type of Hyatt Hy-Load. Whether you select a separable or non-separable type of Hyatt Hy-Load, they are available in a wide range of sizes.

HYATT ROLLER BEARINGS

Basic design simplicity of the *exclusive* Milton Roy liquid end step-valve assures high and reproducible volumetric efficiency. Self-cleaning *double* ball-checks spin any lodged particle free, are non-clogging, seat positively.

One-Half of One Per Cent Accuracy with this Milton Roy Pump

CONTROLLED VOLUME PUMPING

INSTRUMENTATION

PROCESS CONTROL SYSTEMS

BLENDING AND FORMULATING

On The Job in a leading processing plant, two of these air-powered controlled volume pumps meter deionized water solution from a chemical proportioning system to a key production process. Data obtained from *one full year* of operation showed a pumping accuracy within ½ of one per cent!

This is a typical Milton Roy Pump—one of many types of air-powered or motor-driven positive displacement pumps—in daily use in hundreds of similar operations. In *chemical processing*, for example, they're used in fermentation, pH control, hydrogenation of fatty acids. In the *textile and paper fields*, for resin impregnations, peroxide saturates, finish liquors. In *metals and mining*, for plating solution recovery, ore flotation, diatomaceous earth slurry handling. Wide as industry itself, the application of these pumps gives dollar savings not only in accuracy, but in longer service life and man-hours saved. These pumps meter practically any liquid in capacities from 3 milliliters per *hour* to 45 gallons per *minute* against pressures ranging to 25,000 pounds per square inch. They are available as single or multiple units, or as component parts of complete chemical feed and control systems.

***Bulletin No. 351** gives you facts on Milton Roy **Air-Powered Controlled Volume Pumps** and their application. Write, **now**, for your **free** copy.*

Engineering Representatives in the United States, Canada, Mexico, Europe, Asia, South America and Africa.

Milton Roy COMPANY

Manufacturing Engineers • [illegible] LANE • PHILA. 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

TESTING TIPS

for the maintenance of plant equipment

G-E Wattmeter Speeds Testing Without Slowing Down Production

Just hook a G-E AK-2 wattmeter around the conductor, clip the leads across the line, read power. This simple, quick operation can cut hours from your maintenance schedules without damaging conductors at all.

Costly production shutdowns while gathering power facts are not necessary—if you own an AK-2. Use on insulated as well as non-insulated conductors.

GENUINE VERSATILITY

Its wide variety of uses will make the AK-2 one of your most valuable instruments. You can use it for trouble-shooting, motor-load tests, plant-load surveys, and many other applications.

With the G-E AK-2 hook-on wattmeter, you can get power readings from either single-phase or polyphase circuits. Vars in balanced three-phase circuits can also be measured.

BUILT FOR ACCURACY

A dovetail joint on the magnetic jaws results in a clean, interlocking fit. This means that errors from imperfect closings are cut to a minimum.

Accuracy is further assured by the AK-2's thorough magnetic shielding, which reduces the influence of adjoining conductors to negligible quantities.

WIDE RANGE

The G-E AK-2 hook-on wattmeter will measure from 3 to 300 kw on ranges of 15–600 amperes, and 100–600 volts. Price is $95.53.* For additional details, write for bulletin GEC-951.

*Manufacturer's suggested retail price.

Get Dependable Temperature Measurements with a G-E Dual-range Hand Pyrometer

Here is an instrument as rugged as any shop tool—the FH-1 hand pyrometer. Yet, you can depend on its accuracy in reading after reading—whether you're measuring the temperature of surfaces, liquids, gas or molten metals.

Automatic cold-junction compensation prevents any distortion of the reading from changes in the ambient temperature surrounding the instrument. This feature even compensates for the temperature of the instrument itself.

DUAL RANGE SAVES MONEY

This single unit offers two ranges—0–500 F and 0–1500 F. Besides eliminating the need for buying several single-range pyrometers, the FH-1 cuts hours off testing time. The operator carries only one instrument. Furthermore, he can switch from one range to the other with a simple flick of the thumb.

THREE INTERCHANGEABLE TIPS

A surface tip, an immersion tip for liquids and molten metals, and a two-prong contact are available for the FH-1. Also available are a carrying case, and both flexible and rigid extension arms. Both tips and arms can be changed in a matter of seconds without recalibration or further adjustment.

MORE INFORMATION AVAILABLE

The G-E FH-1 hand pyrometer can help you to eliminate waste resulting from wrong temperature guesses. Write for bulletin GEC-836. Price, including all three tips, both extension arms, and the carrying case, is $191.20.*

Hook-on Volt-ammeter Offers 8 Ranges; Will Measure Motor-starting Currents

Eight easily read scales make the G-E AK-1A hook-on volt-ammeter suitable for a wide range of applications. This versatile instrument offers five current scales—one from 0 to 7.5 amps, to read those low-amp circuits, and four others all the way up to 750 amps. Three voltage scales are provided—from 0 to 150, 300, and 750 volts.

The AK-1A offers value beyond that of an ordinary volt-ammeter by indicating motor-starting currents. A simple screw adjustment of the pointer-stop mechanism gives you this reading.

STURDY, SAFE CONSTRUCTION

A strong Textolite† case enables the AK-1A to stand up against unusual service abuses without cracking or chipping.

Complete insulation, together with the one-hand, hook-on operation means maximum safety to the user. Low price is $66.74.* Send for bulletin GEC-901.

†Reg. trade-mark of General Electric Company

When ordering bulletin, write to Section 602-262, General Electric Company, Schenectady, N. Y.

BUY NOW

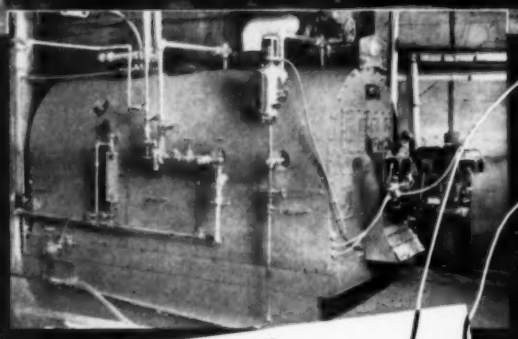
From Your Nearest G-E Distributor

GENERAL ELECTRIC

DUTTON *EconoTHERM* BOILER NOW "Cutting Our Cost of Operation"

says Consumers Company of Racine, Wisconsin

(A well-equipped, all-modern firm, as you can see!)



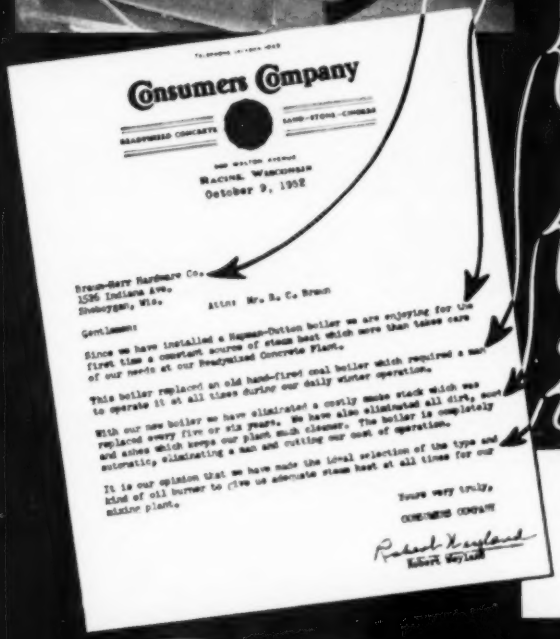
Dutton representative in this area.

Yes — EconoTherm's off-center firing creates positive water circulation for faster steaming; steadier water line, greater safety. FIVE square feet of heated surface per H.P. insures plenty of capacity.

There's a big saving in EconoTherm's automatic operation through electronic controls. Instead of a man's full time, boiler requires just a few minutes' checking daily.

With EconoTherm induced draft fan, you not only eliminate chimney expense, but avoid hot gas "blow-backs" in boiler room! Rotary combustion is clean and highly efficient.

To keep every Dutton EconoTherm owner *equally* pleased is the full-time aim of our engineers, field service men and representatives.



Consumers Company

READY-MIXED CONCRETE — SAND-STONE-GRAVEL

RACINE, WISCONSIN

October 9, 1952

Braun-Kerr Hardware Co.
1536 Indiana Ave.
Sheboygan, Wis.

Attn: Mr. R. C. Braun

Gentlemen:

Since we have installed a Hapman-Dutton boiler we are enjoying for the first time a constant source of steam heat which more than takes care of our needs at our Prestressed Concrete Plant.

This boiler replaced an old hand-fired coal boiler which required a man to operate it at all times during our daily winter operation.

With our new boiler we have eliminated a costly smoke stack which was replaced every five or six years. We have also eliminated all dirt, soot and ashes which keeps our plant much cleaner. The boiler is completely automatic, eliminating a man and cutting our cost of operation.

It is our opinion that we have made the ideal selection of the type and kind of oil burner to give us adequate steam heat at all times for our mixing plant.

Yours very truly,

CONSUMERS COMPANY

Robert Hayland

Robert Hayland

To cut *your* operating cost—and *increase* all-around satisfaction—contact your Dutton representative.

WRITE FOR NEW ECONOTHERM BULLETIN EC-52B.

CHECK FIRST with Dutton

Dutton BOILERS

DIVISION HAPMAN-DUTTON COMPANY

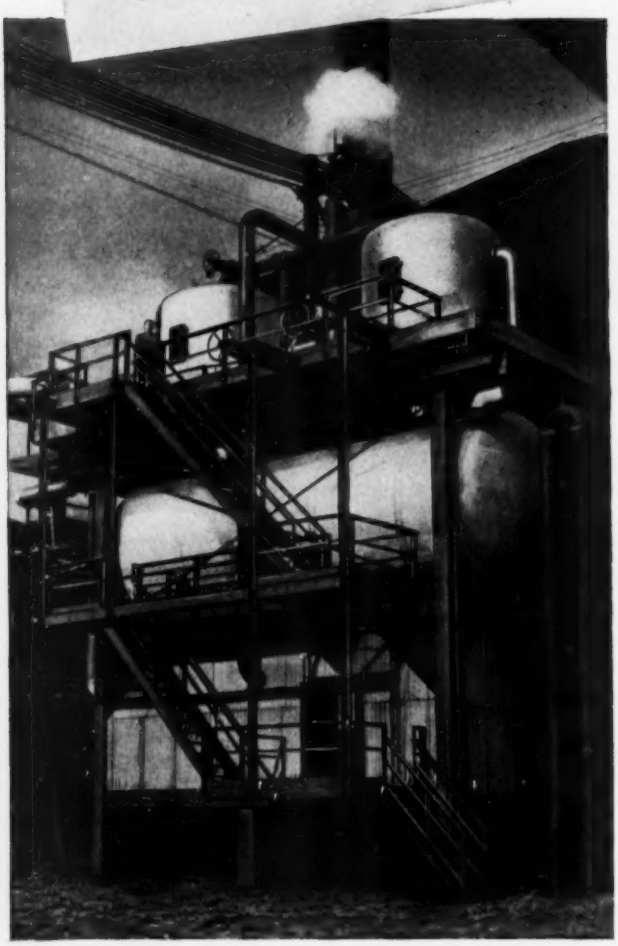
KALAMAZOO, MICHIGAN • BOILER BUILDERS SINCE 1880

FOUR TYPES — SIZES FROM 5 to 250 h.p.

THIS
DEAERATION
PROBLEM

1,000,000 pounds of highly corrosive encrusting feedwater, with hardness up to 35 ppm and temperature at 60F, to be deaerated for boilers operating under *variable load* conditions at 225 psig and 575-600F at a large eastern steel mill.

Solved by Graver



THE GRAVER SOLUTION

Two Graver Spray-Tray Deaerating Heaters mounted on a single horizontal storage tank and equipped with internal vent condensers.

Graver non-clogging, non-corrosive spray valves are used for first-stage deaeration, and stainless-steel non-corrosive trays are used for second stage deaeration.

A Graver internal vent condenser eliminates the possibility of tube scaling which would occur in an external tubular condenser at lower load conditions.

THE GRAVER PERFORMANCE

Even under varying load conditions, tests show that O_2 is kept below 0.005 ml/l, and the entire installation operates without any maintenance attention.

• • • • •

Graver can help solve *your* deaeration problem, too. The more than 40 years of specialized experience of the Graver water conditioning engineers is at your service. Write for free copy of "Trends in Application of Deaerating Heaters for Treating Boiler Feedwater"

GRAVER WATER CONDITIONING CO.
Division of Graver Tank & Mfg. Co., Inc.
Dept. IP-H, 216 West 14th Street, New York 11, N. Y.
In Canada: The Bird-Archer Co., Ltd.; Cobourg, Ontario
In Mexico: Proveedores Tecnicos, S.A.; Puebla 259, Mexico 7, D. F.

GRAVER ***Deaerating Heaters***

GW 463

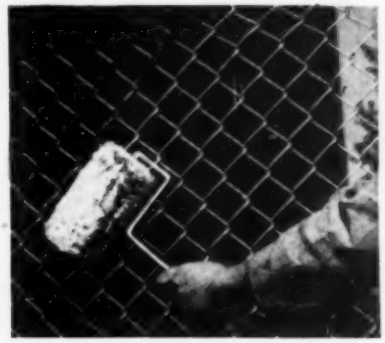
Cut wire fence re-coating costs!

Users Report Savings of 30% to 40% With Rust-Oleum Extra-Long Nap Lamb's Wool Roller!

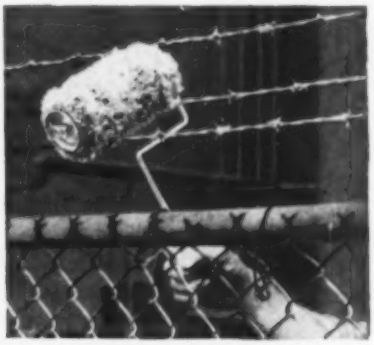
Special roller glides easily over wire sections. (Rusted sections have already been primed with Rust-Oleum 769 Damp-Proof Red Primer to Stop Rust.) Finish coat is Rust-Oleum 470 R.M. Aluminum.

A *new, exclusive, different-type* roller! Greater diameter, specially selected skins, extra-long Lamb's Wool – all combine to give you more coverage faster and easier in the new Rust-Oleum Roller-Coating System.

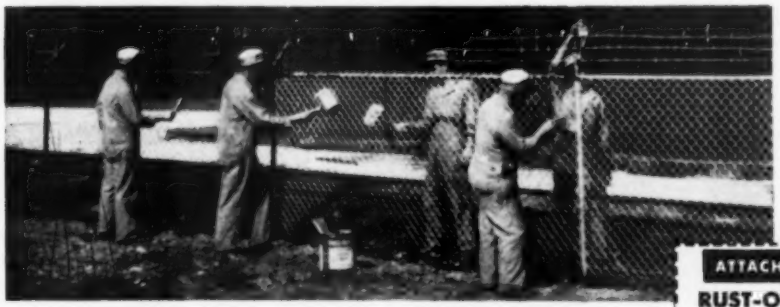
Close-up shows how Extra-Long Nap Wool reaches around to coat approximately 70% of other side of fence at same time. Rust-Oleum's *exclusive* penetrating qualities saturate cross wire sections for desired mil thickness.



Man follows with "dry" roller on opposite side of fence to catch and use surplus "tears" and quickly coat remaining 30% of wire sections.



Even barbed wire sections can be roller-coated in one easy pass. 99% of the material is used on the fence – *not* on the workers, *not* on the ground.



On long distances of fencing, a 5 man production "team" can achieve even greater savings. The first man wirebrushes the surface to remove dirt, dust, rust scale, etc. The second man applies Rust-Oleum liberally by roller, coating the wire sections and barbed wire. The third man follows on the opposite side of the fence with a "dry" roller to catch and use the surplus. The fourth and fifth men work on opposite sides of the fence, brushing the pipe framework and the barbed wire arms. See how this new Rust-Oleum system can save you money. Attach coupon to your letterhead, mail *today*.

RUST-OLEUM®

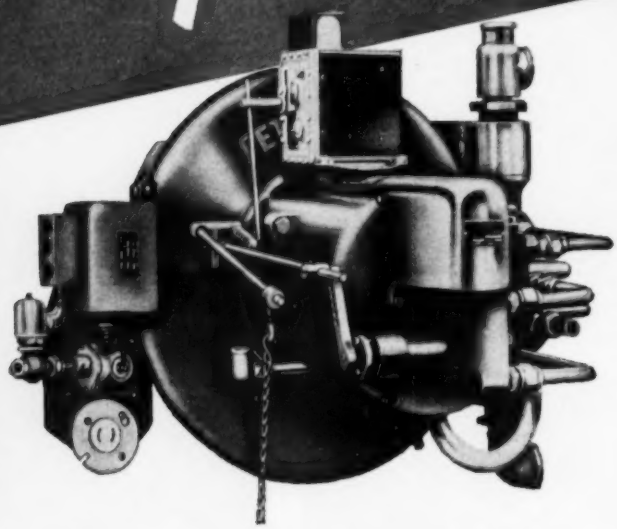
STOPS RUST!

ATTACH TO YOUR LETTERHEAD – MAIL TODAY!

RUST-OLEUM CORPORATION
2474 Oakton Street, Evanston, Illinois

Please show us how your new Extra-Long Nap Lamb's Wool Roller will cut our wire fence re-coating costs. Include prices, complete literature about Rust-Oleum and nearest source of supply. We have approximately_____ yards of wire fencing.

Have you a steam problem?



A Petro INDUSTRIAL OIL BURNER IS THE SOLUTION

Petro industrial oil burners are your best buy! They operate with high efficiency in practically every type of boiler.

Petro oil burners have world-wide acceptance. Their dependability is traditional. They are recommended by leading heating contractors everywhere. Fifty years in oil firing gives the Petro organization an exceptional degree of engineering experience and practical "know how."

Petro's outstanding ability to burn heavy, low-cost oils with maximum efficiency has reduced fuel costs in thousands of plants and buildings.

See Petro section in Sweet's Architectural File, or write for catalog and specifications to Petro, 3174 W. 106th St., Cleveland 11, Ohio.

HERE'S WHAT YOU NEED

You need to CUT STEAM COSTS

A Petro industrial oil burner will do it! The Petro burner is designed to burn low-cost heavy fuel oil with high efficiency and complete reliability. Saves money year after year.

You need to CUT LABOR COSTS

A Petro oil burner will do that, too! Completely automatic, it regulates itself without constant attention; frees attendants for other duties.

You need to MEET FLUCTUATING STEAM DEMANDS

A Petro industrial oil burner does just that! The fire can be modulated to meet the most extreme requirements of varying steam loads.

You need to do all this AT LOW COST without replacing your present boiler equipment.

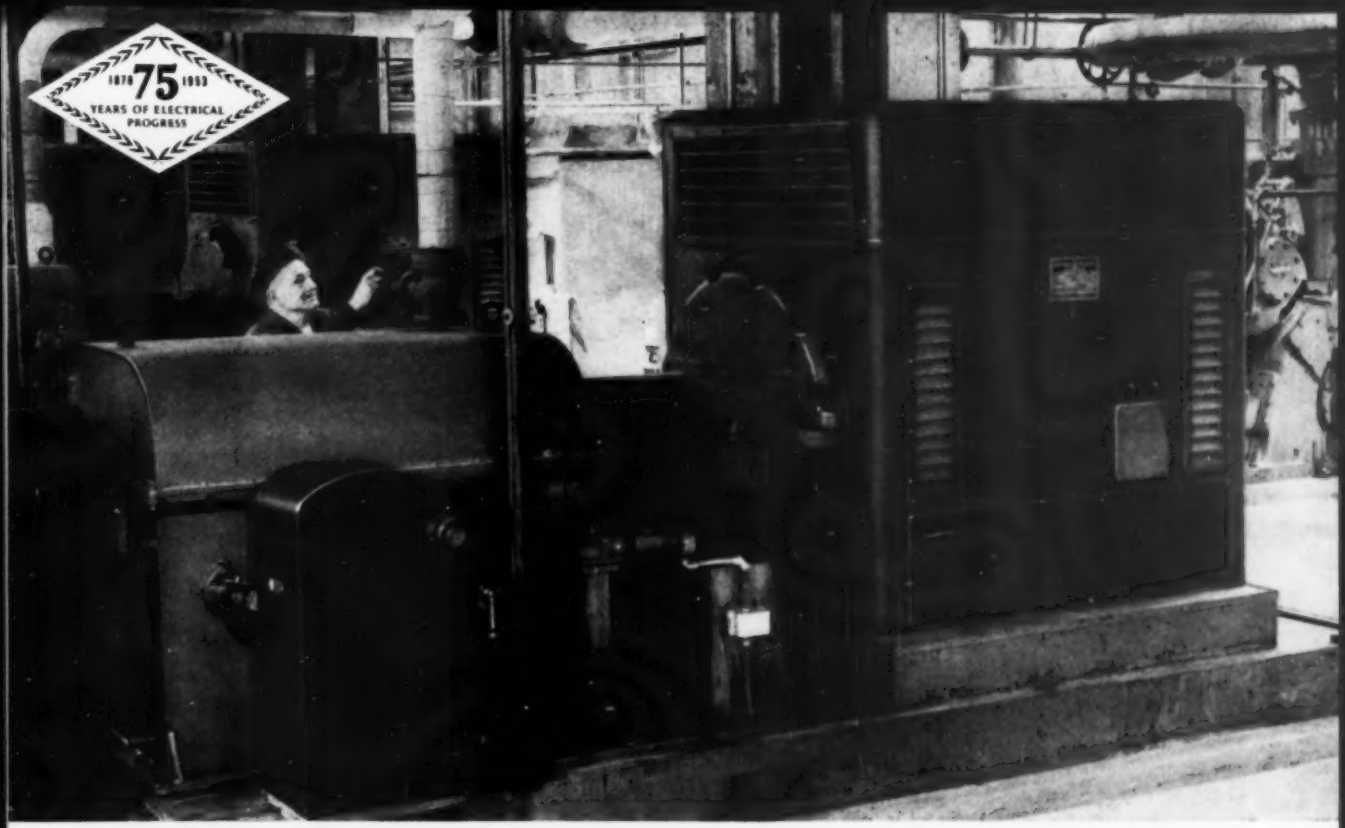
INDUSTRIAL, COMMERCIAL and RESIDENTIAL OIL BURNERS FOR EVERY FIRING NEED

50 Years of Leadership in Automatic Heating and Power Equipment

PETRO

3212 W. 106th St., Cleveland 11, Ohio

In Canada: 2231 Bloor St., West, Toronto, Ontario



MODERN G-E BOILER FEED PUMP MOTORS ARE INSTALLED IN NIAGARA MOHAWK'S NEW ALBANY POWER STATION.

IN DESIGN AND PERFORMANCE—

A True Power Station Motor

When side-air-discharge motor ventilation proved impractical for large boiler fed pump service, we reversed the air flow to expel the warm ventilating air high over the pump. This prevents recirculation of discharge air . . . permits close parallel spacing of motors . . . greatly improves personnel comfort.

In addition to ventilation changes, this modern cubical boiler feed pump motor incorporates the latest advances in bearings, insulation, rotor, and stator design. It's built to serve you with the year 'round reliability the vital power industry requires.

Some of the features of the G-E drip-proof Boiler Feed Pump Motor which make it a true power station motor from top to bottom are:

STREAMLINED ROTOR construction prevents "siren" effect—built-in deflectors and large discharge chamber cut overall noise level considerably.

DUAL LUBRICATION SYSTEM combines the advantages of force-flood lubrication and self-lubricated oil rings . . . gives extra protection . . . assures long, reliable bearing life.

COMPLETE 360 DEGREE ENDSHIELD supports bearing from top as well as bottom . . . assures continuous, accurate bearing lineup. Both endshield halves are sturdy ribbed castings.

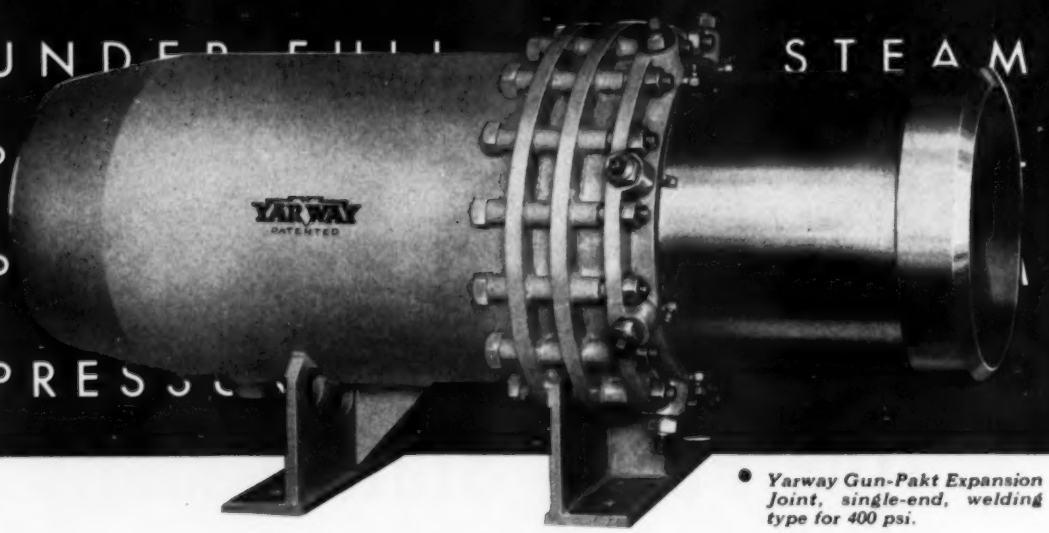
For more information contact your nearest G.E. Apparatus Sales Office or write for Bulletin GEA-5813 to General Electric Co., Section 753-3, Schenectady 5, N. Y.

Conventional motor (top) expels heated discharge air into the aisle—G-E Boiler Feed Pump motor exhausts air high over the pump.

You can put your confidence in—

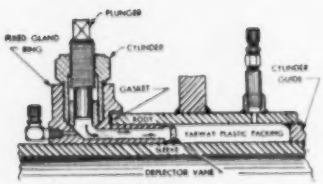
GENERAL ELECTRIC

GUN-PACKED UNDER FULL STEAM PRESSURE • GUN-PACKED UNDER FULL STEAM PRESSURE • GUN-PACKED UNDER FULL STEAM PRESSURE



• *Yarway Gun-Pakt Expansion Joint, single-end, welding type for 400 psi.*

BEHIND IT . . . *AN ENGINEERING REASON*



Cross-section of Gun-Pakt feature.

More large central station heating plants are using Yarway Gun-Pakt Expansion Joints in their steam distribution lines than any other type. This popularity of Yarway Gun-Pakt Expansion Joints in public utilities, institutions and industrial plants is due to the engineering reason behind them . . . *they are packed by a gun under full steam pressure.*

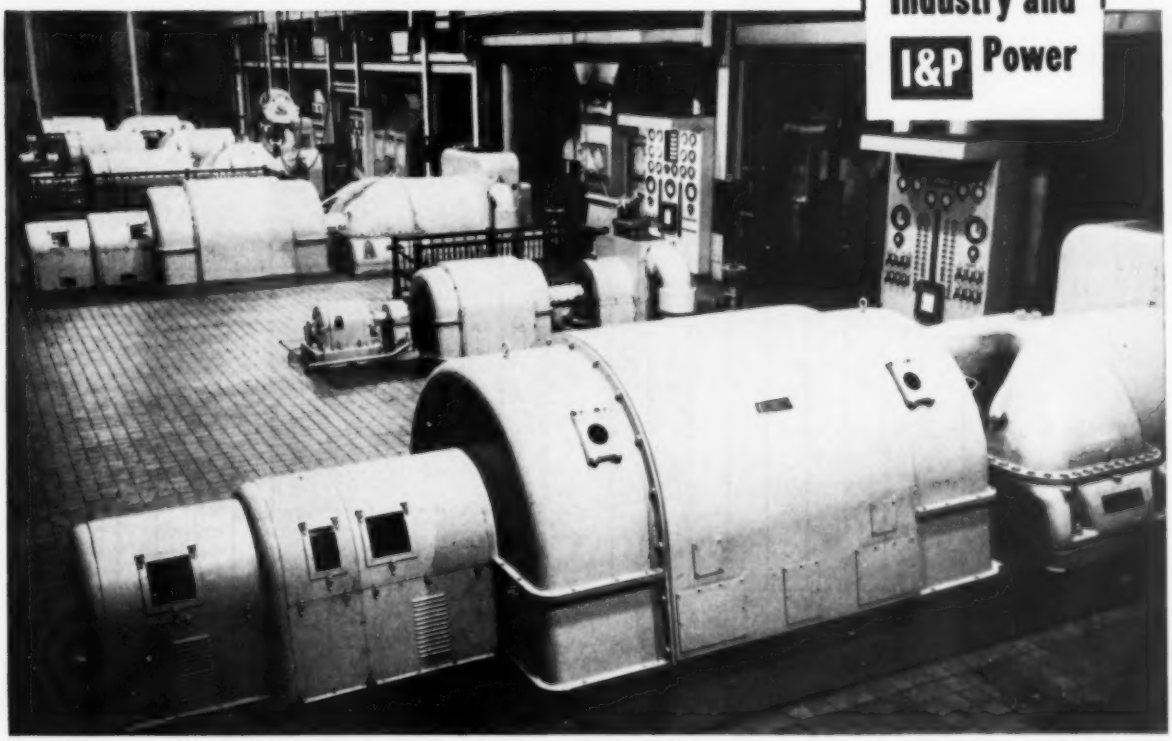
No shutdowns of steam lines, no production delays . . . you just insert a plug of Yarway plastic packing, twist a wrench, and the joint is tight, the job is done.

Such labor saving features, combined with impressive records of low maintenance requirements, make Yarway Gun-Pakt Joints a natural selection for your steam lines. Certainly you'll find them worth investigating.

Write for Yarway Expansion Joint Bulletin EJ-1912.

YARNALL-WARING COMPANY
109 Mermaid Avenue • Philadelphia 18, Pa.

YARWAY | *gun-pakt expansion joints*



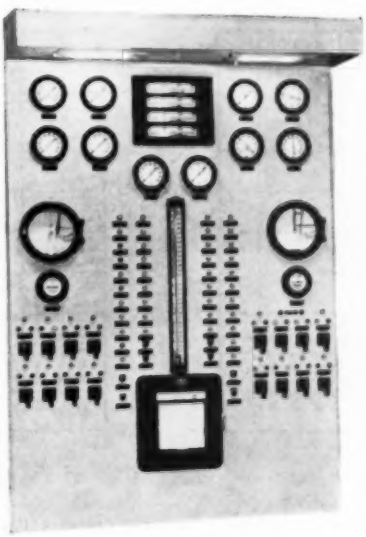
Interior photo shows the new 12,500 kw machine, foreground, followed by one 1000 kw, one 7500 kw, and three 4000 kw units.

Design Details of Piqua Expansion

A complete engineering study, including economic factors, made possible the selection of the right equipment to integrate the old and new at Piqua, Ohio's Municipal Station.

CHARLES J. LAHMAN
Mechanical Engineer
W. I. Barrows & Associates

JOHN P. GALLAGHER
Director of Municipal Utilities
Piqua, Ohio



Both turbine and turbine auxiliary controls are mounted on this panel.

PIQUA, OHIO, a progressive city of 18,000 population located in the rich Miami Valley region, recently installed new power generating equipment to complete the second phase of an expansion program started in 1944. The latest addition, consisting of a 12,500 kw, nonautomatic extraction, condensing turbine-generator and a 150,000 lb per hr steam generating unit, brings the electrical name plate capacity of the station up to 41,250 kva and the steam name plate capacity up to 450,000 lb per hr. The Piqua power plant has enjoyed continual growth since 1939 and is now one of the largest and most successful municipal systems in the State of Ohio. Plant output in kilowatt hours for the past 13 years is shown in Fig. 1.

Based on present loads, the plant has a reserve electrical generating capacity of 134 per cent of rating, or a firm capacity (with 100 per cent reserve) at rating of 34 per cent with modern, efficient generating equipment. Fig. 2 illustrates the relation-

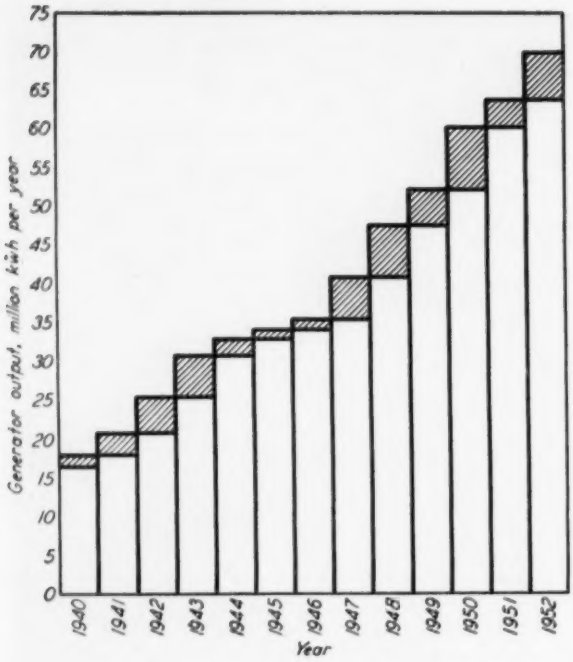


Fig. 1—Annual kwh generation and rate of load growth.

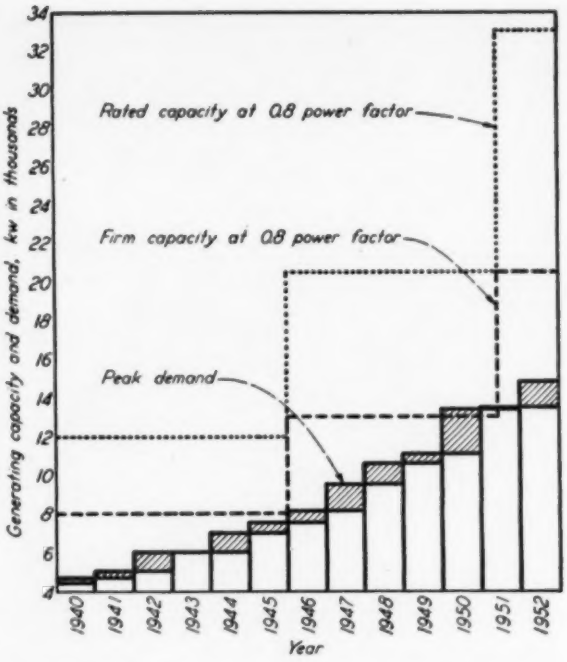

Rated capacity at 0.8 power factor
Firm capacity at 0.8 power factor
Peak demand
Generating capacity and demand, kw in thousands
Year

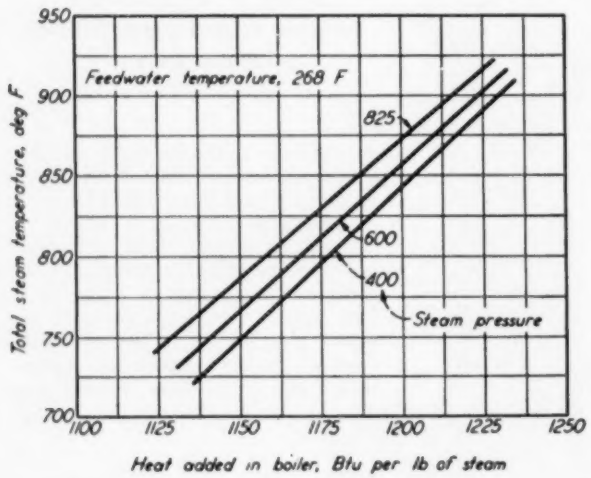
Fig. 2—Comparison of peak demands and plant capacity.

ship between firm and rated capacity as well as the actual annual peak kilowatt demand. When the carrying capacity of the plant for short overload periods and for power factor improvement is considered, the Municipal Power System is in the enviable position of being able to assure adequate generating capacity in the Piqua area for continued increases in residential, commercial, industrial, and wholesale electric demands.

The expansion program was planned after careful investigation by the engineers, W. I. Barrows & Associates, working in close conjunction with Director of Municipal Utilities, John P. Gallagher. The project was under the direction of City Manager Robert M. Hance, Jr., Mayor Wilbur Reck, and the City Commissioners. All these principals recognized the fact that it was vitally necessary to provide dependable services to the community and industries of Piqua at rates which would enable both the Municipal Plant and its customers to meet competitive costs with equal or better service. This basic concept was the primary consideration during all phases of the project.

Installation Costs

That the results of this applied effort and cooperation were gratifying is manifest by the unusually low installation cost of less than $1,100,000, or approximately $88.00 per kva of capacity, based on turbine name plate rating. The initial phase of the expansion program, completed in 1946, included: one, 9375 kva, nonautomatic extraction, condensing turbine-gener-



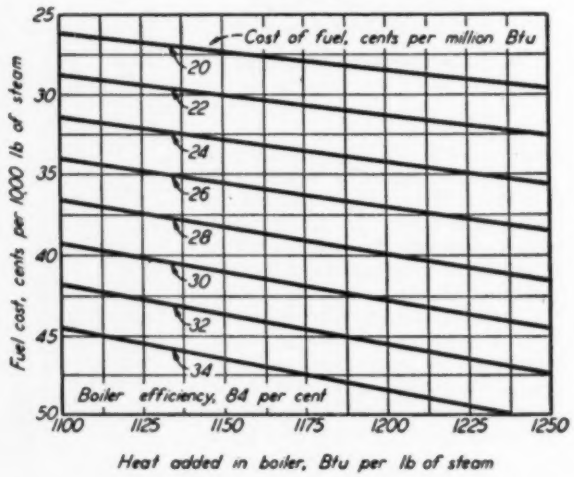
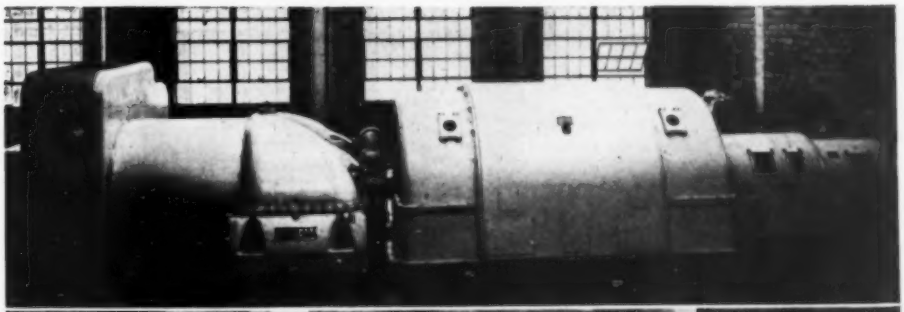
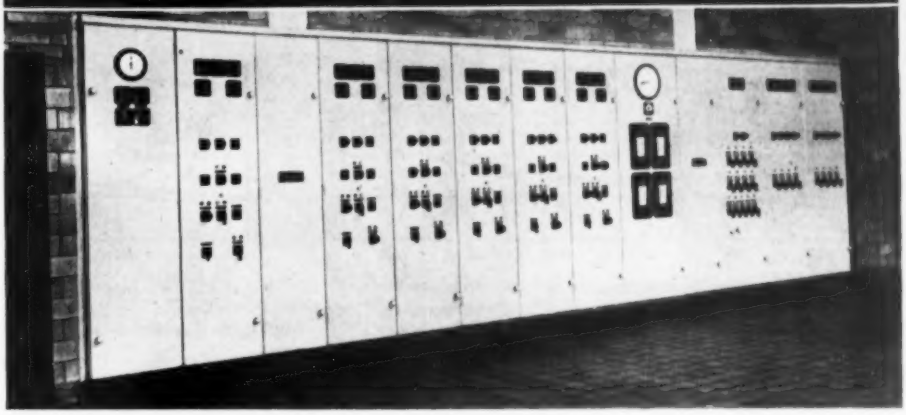


Fig. 3—Chart of fuel costs in cents per 1000 lb of steam at various pressures, temperatures, and delivered fuel prices.



Unit is multiple stage, nonautomatic extraction, condensing with four extraction openings; uses 400 psig-750 F TT steam.



One control panel serves all generators and main distribution feeders. The synchroscope panel, left, is hinged so that it can be readily observed when closing circuit breakers.

ator; one, 1250 kva, back pressure turbine-generator; one, 150,000 lb per hr steam generating unit; and the necessary coal handling equipment and building enlargement for both phases of the program. It was completed at a cost of $113.50 per kva. The total cost of both phases approximated $2,300,000, or about $100.00 per kva of capacity. This low cost was realized despite the fact that the boilers have surplus capacity for serving an underground steam distribution system operated in conjunction with the plant.

Preliminary studies for the recently completed installation began in 1948 and included: (a) analysis of station capacity vs station demand for both past and predicted future loads, (b) determination of steam pressure and temperature at the turbine throttle, (c) selection of equipment size and type, and (d) estimation of cost for both installation and operation.

Steam Conditions

When establishing throttle steam conditions, a comprehensive study of required investment, efficiency, operating conditions, maintenance, and existing facilities was prepared to assure the most economical and advisable selection. It was recognized that high pressure-high temperature design would effect savings in operating costs as the load increased. Thus, comparison was made on the basis of the largest size equipment practical at the time with regard to both load demand and space limits in the existing building.

With these thoughts in mind, first consideration was given to a 15,000 kw turbine-generator designed to operate at 80 per cent power factor and 2 in. Hg abs back pressure. This unit was considered on the basis of the most favorable condition which could be assumed—100 per cent annual avail-

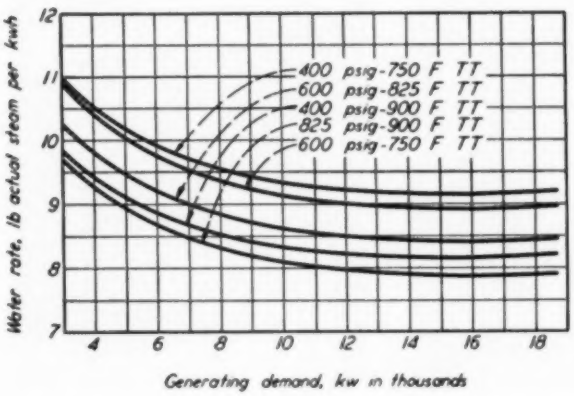


Fig. 4—Condensing cycle water rates of 15,000 kw unit at 0.8 power factor and 2 in. Hg absolute back pressure.

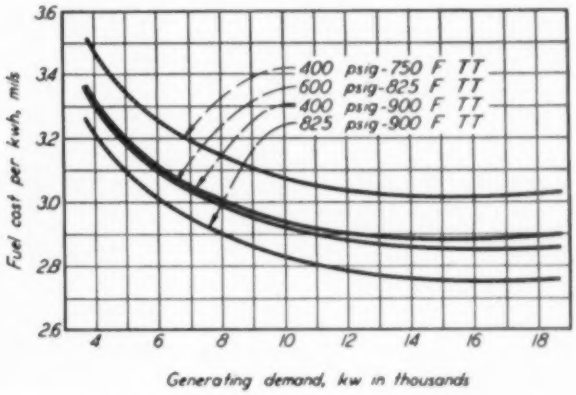


Fig. 5—Fuel costs in mils per kwh for 15,000 kw unit based on 12,000 Btu coal at 24 cents per million Btu.

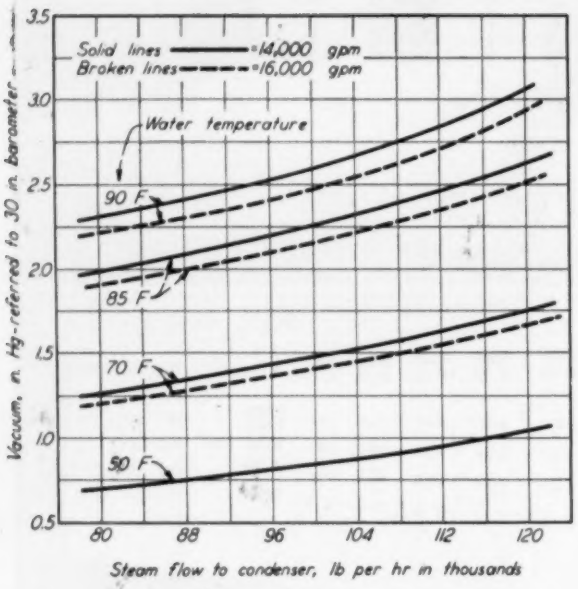


Fig. 6—Performance of 12,000 sq ft surface condenser.

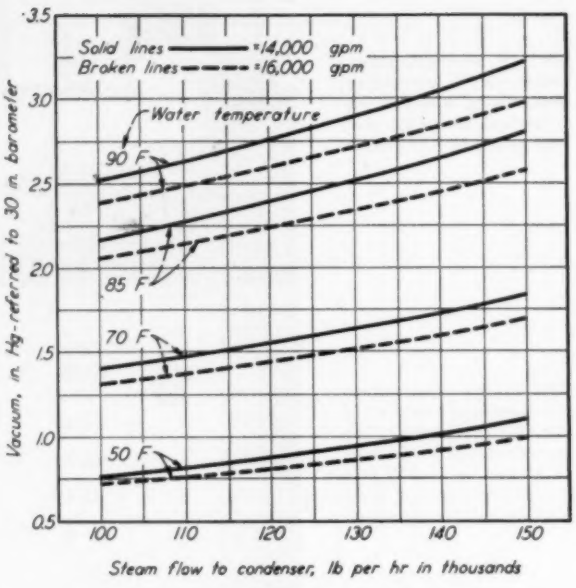


Fig. 7—Performance of 15,000 sq ft surface condenser.

ability when fully loaded with regard to station load factor. Also, although continuous operation of the unit at full rating was not anticipated for the next 15 years, the comparison was extended to cover the possibility of an annual 15,000 kw base load.

Steam condition studies were based on turbines designed for 400, 600, and 825 psig pressure at total steam temperatures of 750, 825, and 900 F with the most serious consideration being given to throttle conditions of 400 psig—750 and 900 F TT, 600 psig—825 F TT, and 825 psig—900 F TT.

Evaluation Studies

When comparing costs, Fig. 3 was developed to show fuel costs per 1,000 lb of steam for varying pressures, temperatures, and fuel rates, based on a boiler efficiency of 84 per cent and inlet feedwater temperature of 268 F. This information and the straight condensing water rates, shown on Fig. 4, at the four throttle steam conditions most seriously considered, were used to compute Fig. 5, which presents fuel costs per kwh based on a fuel price of 24¢ per million Btu.

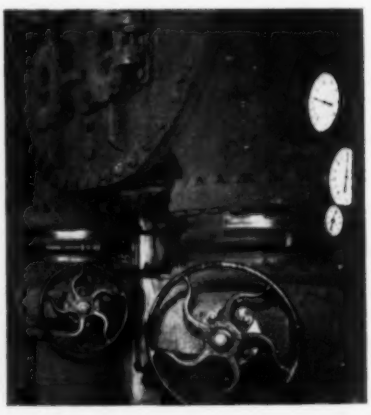
Other costs, including burden on the investment, operation, and maintenance, were developed and added to the calculated fuel costs to establish the total annual cost per kwh. The possible annual savings thus computed were measured to less than half a hundredth of a mil per kwh. However, the studies indicated that considerably more savings could be accomplished at this plant by the judicious purchase of fuel. In fact, it was found that a variation of one cent per million Btu in the cost of fuel would change the annual generating cost per kwh by about four times as much as all of the other factors considered in this cost comparison.

Design Considerations

A number of conditions peculiar to this plant entered into the study. Total annual generation, design conditions (400 psig—750 F TT) for the existing equipment, over-all plant heat balance, fuel cost, and the relatively large volume steam demands of an underground distribution system supplied by the plant had to be considered. Furthermore, in order to coordinate the new boiler unit in the existing plant capacity picture, it was deemed necessary to base all comparisons on the installation of a 150,000 lb per hr steam generating unit. All capital investments and operating costs were evaluated on this basis.

All of these factors influenced the decision to stay with the existing steam conditions of 400 psig — 750 F TT. This decision should not be construed as being applicable to another plant where conditions may be such as to produce exactly opposite results. It is obvious that different conclusions could be reached for an entirely new plant and diverse service requirements.

The dominant factor in the selection of fuel was the geographical location of the plant site, since low quality, low



Cork insulation was applied to the condenser and the circulating lines.

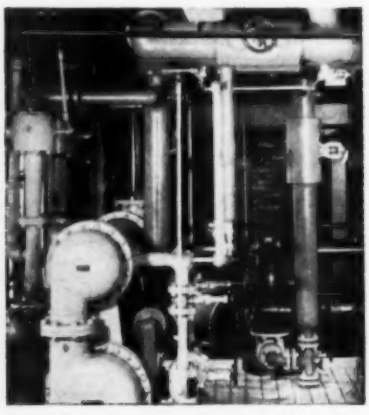
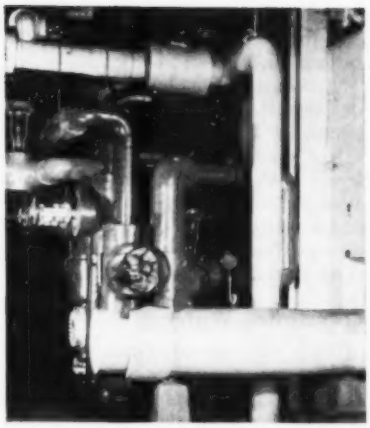
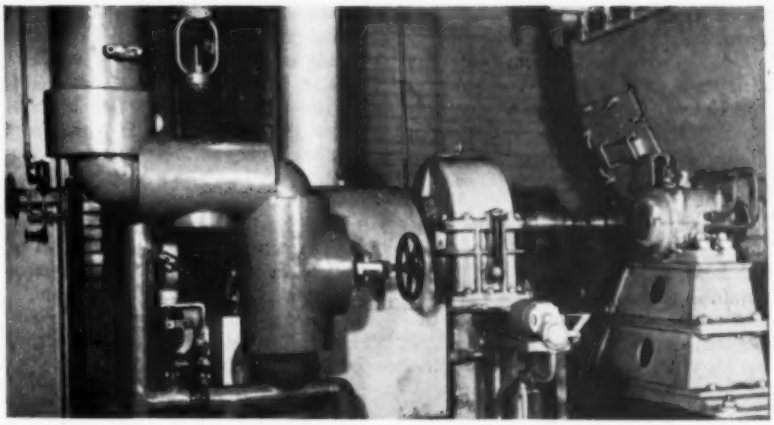


Photo shows the twin, two stage air ejector and the starting evacuator.



The high pressure stage heater has a 200,000 lb per hr design capacity.



Dual steam turbine and electric motor drives are used on most of the major auxiliaries to assure operational flexibility and improve plant heat balance.

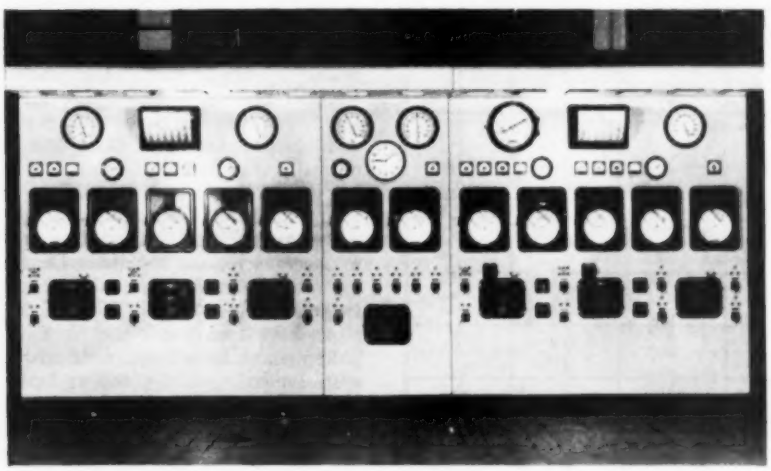
priced, bituminous coal is readily available. A traveling grate stoker was selected as the type of firing equipment best suited for proper utilization of this fuel. With this type of stoker, the maximum temperature of the air entering the furnace must be held within specified limits. This dictated the use of a combination of a relatively small air heater and a small economizer for reducing the exit gas temperature to obtain higher thermal efficiency.

Stage Heating

Since using an economizer would limit the amount of stage heating which could be accomplished by virtue of nonautomatically extracted steam from the turbine, studies were conducted to determine the most desirable arrangement of heat recovery equipment. Reference to available data as published by turbine manufacturers indicated that a 15,000 kw turbine-generator operating at 825 psig—900 F TT, 2 in. Hg abs back pressure, and 100 per cent load has a throttle water rate, with three stages of heating, of 8.34 lb per kwh. This equals a throttle flow of 125,100 lb of steam per hr, and the resulting feedwater temperature is 280 F. With four stages of heating, the water rate is 8.70 lb per kwh, the throttle flow is 130,500 lb per hr (4.3 per cent higher), and the feedwater temperature is 347 F (67 F higher), or too hot to introduce into an economizer and thereby derive any benefit.

Similar information was obtained for an 11,500 kw standard machine operating at full load with steam conditions of 600 psig—825 F TT. This unit has a water rate of 9.15 lb per kwh when using three stages of heating, or a total throttle flow of 105,200 lb per hr and a resulting feedwater temperature of 270 F. The water rate with four stages of heating is 9.62 lb per kwh, which equals a throttle flow of 110,600 lb per hr (5.1 per cent higher) and results in a feedwater temperature of 343 F (73 F higher). This is also too hot to obtain benefit from an economizer.

These studies showed that using the fourth stage of heating and eliminating the economizer would require increased throttle flows to the steam turbine of four to five per cent and would result in one to three per cent lower steam generating unit efficiencies. Therefore, full use of stage heating is not warranted, which is a condition peculiar to this plant. Ultimate analysis further proved that operating conditions made it more practical to use



Boiler panel has master controls, center; No. 4 boiler controls, left; and new No. 5 boiler controls at right. Note duplication of design in new panel.

Stoker front enclosure was designed at Piqua. Unit minimizes air leakage.

steam from the back pressure unit (which supplies steam to the underground distribution system) for the final stage of heating the feedwater to 268 F before entering the economizer. Thus, only two stages of heating from the turbine-generator were utilized.

Equipment Selection

After the throttle steam conditions were established, the next step was the selection of the equipment size as determined from present and anticipated future load conditions. In view of the fact that the plant is an isolated power station, serious consideration was given to the selection of a generating unit that would coincide with the existing generators to assure a safe amount of rolling reserve.

The steam turbine selected is a multiple stage, nonautomatic extraction, condensing unit rated at 10,000 kw at 80 per cent power factor. Extraction openings are provided at the fourth, fifth, seventh, and eleventh stages. Present conditions allow practical use of only the fifth and eleventh stages for feedwater heating; the fifth stage for the deaerating heater and the eleventh stage for a low pressure, closed heater. Water rate at the throttle conditions of 400 psig—750 F TT with 2 in. Hg abs back pressure is 9.39 lb per kwh at full load.

This turbine drives an oversize, air-cooled generator equipped with direct connected exciter. The generator has a rating of 12,500 kw at 80 per cent power factor so that sufficient capacity is available to handle unity rating of the steam turbine without overheating the generator. The air cooling system is completely housed within the foundation to assure clean recirculated air. Hydrogen cooling was not available for this size generator.

Several principal factors governed these equipment selections. First, the firm capacity of the station (considering the largest unit out of service for the present time) was the summation of the capacity of the existing smaller generators. Second, installation of this unit in the existing space did not present as many obstacles as the next larger sized unit. Third, the unit afforded better condensing rates at high loads because space conditions, without building changes, limited the size of the condenser. Fig. 6 and Fig. 7 were developed to show relative condenser performance at various flow rates before the 12,000 sq ft, spring mounted, surface unit was definitely selected.

Auxiliaries provided with the condenser include two condensate pumps, one motor and one turbine driven, and a control for maintaining constant level in the condenser hot well. In addition, a twin, two-stage air ejector and a starting evacuator were located on a platform accessible from the operating floor or from the basement floor.

Circulating Water

Since the city of Piqua, Ohio, is situated on the Great Miami River, water for condensing purposes is brought from the river to the power plant and returned through concrete aqueducts beneath the station. These aqueducts were installed during the first phase of this expansion program. The inlet aqueduct has a vertical traveling refuse screen to remove leaves and debris from the circulating water.

Water is pumped to the condenser by two, vertical, 7000 gpm pumps. The circulating water piping to the divided water boxes is arranged for flexibility of operaton so that one or both pumps can supply all condensers. Normally, unit pumping is employed. Both new pumps are motor driven, but in event of power failure, circulating water is supplied by other turbine driven pumps, which are arranged to start automatically.

Steam Generator

Steam requirements for the turbine-generator were not the governing factor in the selection of the boiler because of the steam supplied to the underground distribution system. This condition dictated the use of an oversize steam generator to afford flexibility of operation in the boiler room and to provide ail possible firm steam capacity. Therefore, the steam generating unit selected is a 150,000 lb per hr boiler equipped with water cooled furnace; superheater; two-pass, tubular, parallel flow air heater; and continuous loop economizer. The unit is normally fired by a dual driven traveling grate stoker. Auxiliary oil burners of the mechanical atomizing type, designed to produce 2/3 of rated capacity in emergencies are installed. Design steam conditions at the superheater outlet are 450 psig—750 F TT at an efficiency of 85 per cent.

References have been made to the space limitations of the existing building. It should be a matter of interest that the new equipment was installed in the same 103 ft building width as provided for the initial units, which had a capacity of only 5000 kva and 50,000 lb of steam per hr. The new equipment af-

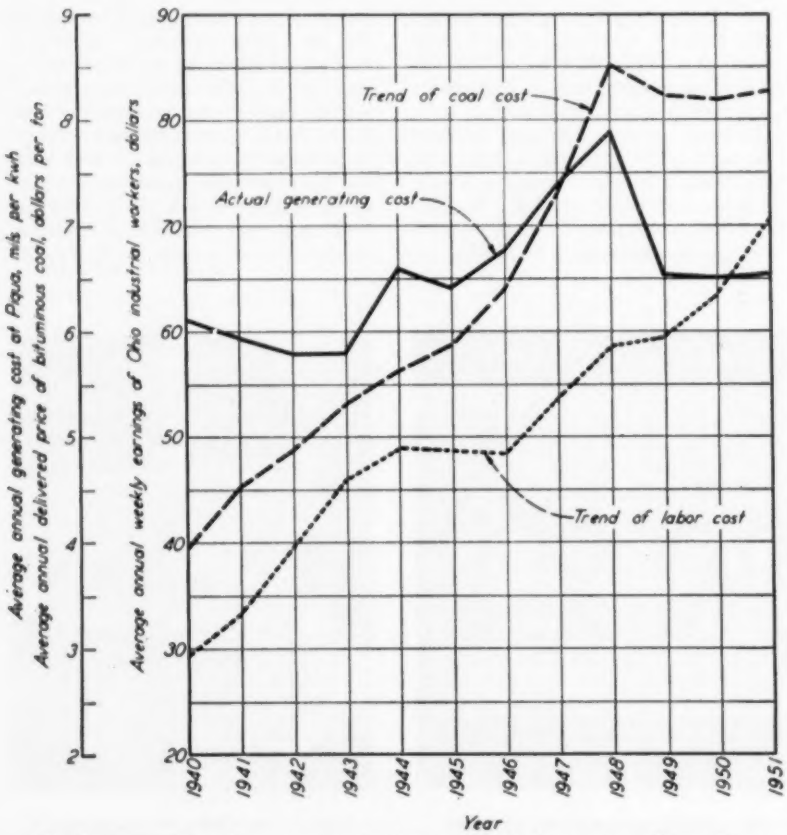


Fig. 8—Comparison of average generating, coal, and labor costs at Piqua plant.

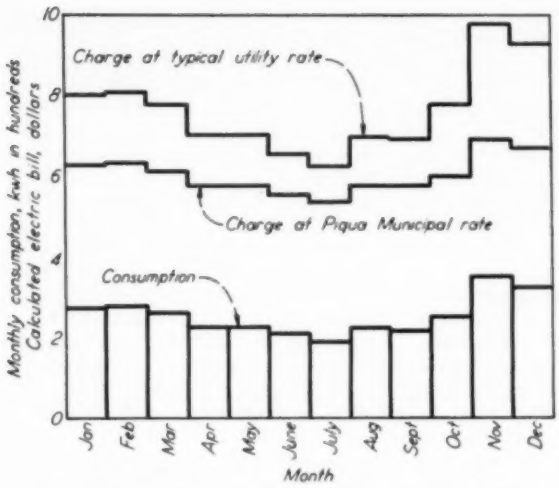


Fig. 9—Chart shows a representative residential load and charges at both Piqua and typical utility rates.

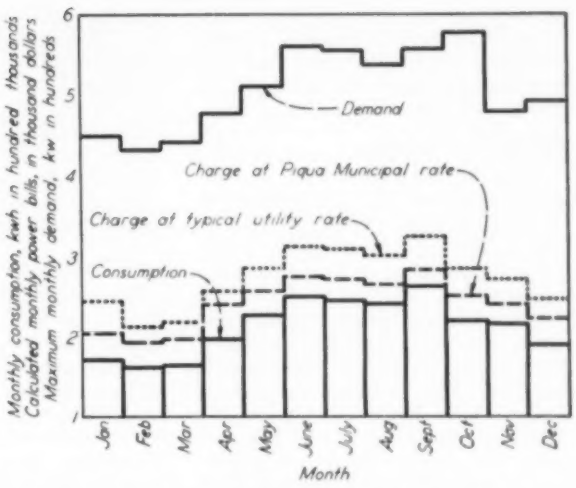


Fig. 10—Chart shows a representative industrial load and charges at both Piqua and typical utility rates.

fords 2½ to 3 times greater capacity.

Both forced and induced draft fans are equipped with dual drives. Normal operation is by motor, and the mechanical drive turbines are arranged for remote control operation in event of power failure. The duct work is arranged to permit individual bypassing of the economizer or air heater, and natural draft bypassing of both. Air jets in the front and rear walls, supplied by a constant speed fan having adjustable inlet vanes, create necessary overfire turbulence.

Coal and Ash Handling

During the first phase of the expansion program, coal handling equipment was installed, consisting of a primary track hopper pit with bucket elevator, a secondary emergency track hopper pit with mass flow elevator, a distributor conveyor, an overhead catenary type coal bunker and a motor propelled weigh larry. Furthermore, the plant is constructed so that ashes can be removed by direct dumping into a motor truck, through water flushed power dump gates in the ash pit.

Two, 400 gpm main boiler feed pumps were installed. One unit is a motor driven, four stage pump with excess pressure governor, and the other is a steam turbine driven, four stage pump with differential pressure governor. In addition, the system includes a feedwater regulator for each boiler.

A 300,000 lb per hr, horizontal, deaerating feedwater heater was installed to serve the new steam generating units. The horizontal type was selected over the vertical type because of height limitations, since a 125,000 lb per hr unit originally occupied the same space. The new heater is equipped with the customary auxiliaries such as vent condenser, regulating valve, overflow trap, and other typical equipment.

Provisions for Emergencies

Piqua's power plant has no outside source of power to assist in starting up or in carrying load. Thus, the system has been engineered with automatic and remote controls for the steam auxiliaries to effect where possible, in case of power failure, the return to normal service within three minutes. These controls minimize serious interruptions by conserving steam, controlling residual furnace heat, maintaining continuous steam generation, and providing positive pumping service.

Safety features include solenoid operation of pilot or main control valves in the steam lines to the auxiliary turbines driving the boiler feed pump, fuel oil pump for the emergency oil burners, forced and induced draft fans, and circulating water pump. Solenoid valves were installed in the cooling water lines for those auxiliaries. When these solenoid valves are actuated either by loss of line current to their companion motor driven auxiliaries or by remote manual control, they automatically place the steam units in operation.

Service Continuity

Records show the plant has maintained excellent service continuity over the past eight years. During this time, the flexibility of the equipment and the alertness of the operating crew have combined to limit service interruptions to: (a) one of two minutes duration caused by blasting for construction work which tripped the machine, (b) another approximately two minutes long when a throttle valve trip lever was accidentally hit by a construction worker, (c) a 45 minute period during

TABLE 1 — RECORD OF STATION PERFORMANCE

Year	Total annual generation kwh	Turbine heat rate Btu per kwh	Unit generating cost mills per kwh
1940	18,051,900	15,002	6.11
1941	20,796,200	13,963	5.93
1942	25,304,660	14,194	5.78
1943	30,723,640	14,309	5.79
1944	32,865,400	15,002	6.59
1945	34,330,046	15,117	6.42
1946	35,464,660	15,348	6.77
1947	40,922,600	16,040	7.38
1948	47,426,682	14,771	7.90
1949	52,174,200	13,963	6.54
1950	60,103,400	13,617	6.51
1951	63,594,500	14,194	6.55

the night when a generator was pulled off the line for safety reasons because of flash-over of collector rings, and (d) two 2-minute successive interruptions due to switchgear difficulties.

Operating Results

Table 1 shows the record of performance which the plant personnel has accomplished. The unit generating cost figures listed are the result of an annual boiler efficiency of slightly over 83 per cent.

These relatively low costs have been achieved by unceasing efforts to combat the rising costs of fuel, wages, and materials. The results are depicted in Fig. 8 which shows: the average annual total generating cost in mils per kwh; the annual delivered cost per ton of representative bituminous coal over the same period of time, as published by a reliable source; and the estimated average annual weekly earnings of Ohio industrial workers under Ohio Unemployment Compensation Law, as published by the Division of Research and Statistics. It will be noted that coal increased 110 per cent and wages increased 141 per cent between 1940 and 1951, but the generating cost for the Piqua Plant was only 7.2 per cent higher during the same period.

Low Cost Service

The culmination of these efforts has been the ability to provide Piqua with reliable electric service at low rates, enabling industries to be competitive and encouraging home owners and residents to enjoy all of the advantages and conveniences of modern electrical appliances. Rates have proven to be cheaper than prevailing public utility rates in the area as demonstrated by Fig. 9, showing a representative residential service, and Fig. 10, showing a representative industrial service. This invites community growth and promotes progress. In addition to these comparatively low rates, the Municipal Plant is able to absorb the costs* of street lighting and street lighting improvements for the city.

Further incentive for residents to avail themselves of the benefits of modern, comfortable living is reflected in the special rates of one cent per kwh offered for residential hot water service and for residential heating. The one cent rate also is available to all residential consumers for energy used in excess of 200 kwh per month.

*Annual operation and maintenance cost of street lighting amounts to $37,000.00, equal to about 2 mils on the tax duplicate. Street lighting improvements over the past five years amounted to slightly over $250,000.

PRINCIPAL POWER PLANT EQUIPMENT

Steam Generating Equipment

Boiler	Combustion Engineering, Inc.
Two drum type with continuous loop Elesco superheater, steam capacity 125,800 lb per hr continuous, 150,000 lb per hr for 4 hours, 450 psig—750 F TT, total heating surface 16,490 sq ft, water wall surface 2775 sq ft, tubular air heater surface 6400 sq ft, economizer surface 2500 sq ft, furnace volume 7200 cu ft, heat release 29,850 Btu per cu ft per hr	
Stoker	Combustion Engineering, Inc.
Traveling grate, seven zones, grate area 460 sq ft, burning rate 43½ lb per sq ft per hr	
Stoker turbine	Carling Turbine Blower Co.
Stoker motor	General Electric Co.
Variable speed drive	Reeves Pulley Co.
Oil burners	Peabody Engineering Corp.
Four, forced draft, mechanical atomizing	
Forced draft fan	American Blower Corp.
Double inlet, nonoverloading, 53,000 cfm at 6.15 in. wg, 1170 rpm, inlet vane control	
Forced draft fan turbine	Elliott Co.
75 hp, geared 3815/1170 rpm, 175 psig — 600 F TT, 5 psig back pressure	
Forced draft fan motor	Elliott Co.
Two speed 75/25 hp, 1200/900 rpm	
Induced draft fan	American Blower Corp.
Double inlet, 94,500 cfm at 9.1 in. wg, 695 rpm, inlet damper control, evase discharge	
Induced draft fan turbine	Elliott Co.
200 hp, geared 3500/700 rpm, 175 psig — 600 F TT, 5 psig back pressure	
Induced draft fan motor	Elliott Co.
Two speed, 200/65 hp, 710/505 rpm	
Free wheeling clutches	The Hilliard Corp.
Couplings	John Waldron Corp.
Overfire air fan	Clarage Fan Co.
4500 cfm at 24 in. wg and 240 F	
Overfire air fan motor	Elliott Co.
30 hp, 3600 rpm	
Boiler and stoker erection	Oberle-Jordre Co.

Boiler Accessories

Soot blowers	Diamond Power Specialty Corp.
Steam actuated, two retractable, 15 conventional	
Hydraulic ash gates	Allen-Sherman-Hoff Co.
Water column	Yarnall-Waring Co.
Blowoff valves	Yarnall-Waring Co.
Safety valves	Manning, Maxwell & Moore, Inc.
Nonreturn valve	Edward Valves, Inc.

Instrumentation and Controls

Turbine instruments and panel	Republic Flow Meters Co.
Control centers	Westinghouse Electric Supply Co.
Switchgear	General Electric Co.
Combustion control and cubicle	Leeds & Northrup Co.
Boiler meter	Bailey Meter Co.
CO_2 meter	Leeds & Northrup Co.
Solenoid valves	Automatic Switch Co.

Power Generating Equipment

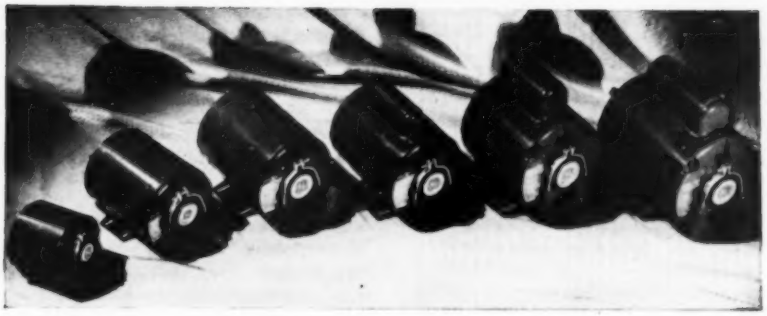
Turbine	Elliott Co.
Multiple stage, 12,500 kw (at 5/4 load), 400 psig — 750 F TT, operating back pressure 2.0 in. Hg, four extraction openings	
Generator	Elliott Co.
12,500 kw at 80 per cent power factor, 3600 rpm, 4160 volt, 3 phase, 60 cycle with 250 volt direct connected exciter	
Condenser	Elliott Co.
Surface type, 12,000 sq ft, two pass, two compartment	
Air ejector	Elliott Co.
Twin, two stage, 375 psig — 700 F TT	
Starting evacuator	Elliott Co.
500 lb per hr at 10 in. Hg abs	
Air cooler	Griscom-Russell Co.
Surface type, 6000 sq ft, two pass, low head loss	
Oil cooler	Bell & Gossett Co.

Condensate and Feedwater System

Condensate pumps	Elliott Co.
Horizontal, two stage, 160,000 lb per hr, 125 ft head	
Condensate pump turbine	Elliott Co.
25 hp, 400 psig — 750 F TT, 10 psig back pressure	
Condensate pump motor	Elliott Co.
25 hp, 1750 rpm	
Hot well level control	Fisher Governor Co.
Circulating pumps	Worthington Corp.
Vertical, 7000 gpm, one single discharge, one double discharge	
Circulating pump motors	General Electric Co.
100 hp, 1200 rpm	
Boiler feed pump	Goulds Pumps, Inc.
Four stage, 400 gpm, 1300 ft head, 220 F	
Boiler feed pump motor	Elliott Co.
200 hp, 3550 rpm	
Excess pressure governor	Swartwout Co.
Boiler feed pump	Worthington Corp.
Four stage, 400 gpm, 1300 ft head, 220 F	
Boiler feed pump turbine	Elliott Co.
200 hp, 3600 rpm, 175 psig — 600 F TT, 10 psig back pressure	
Differential pressure governor	Fisher Governor Co.
Deaerating heater	Cochrane Corp.
Horizontal, 300,000 lb per hr, 5 psig back pressure	
High pressure stage heater	Henry Vogt Machine Co.
Low pressure stage heater	Ross Heater & Mfg. Co.
Feedwater regulator	Northern Equipment Div.
Feed stop-check valve	Edward Valves, Inc.
Multiport relief valve	Cochrane Corp.
Atmospheric relief valve	Atwood & Morrill Co.
Butterfly valves	S. Morgan Smith Co.

Miscellaneous

Valves and fittings	Crane Co.
Prefabricated piping	Crane Co.
Piping erection	E. W. Fila Co.
Foundations	Plant personnel



Fractional horsepower induction motors (left) are the most widely used of this kind and typify the trend which has endured from the first use of electric motors; new materials and design conceptions have permitted engineers to periodically shrink motor sizes so that given frames house larger-rated units.

Late Trends in Polyphase Induction Motors

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Consulting Engineer
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EVERY EIGHT OR TEN YEARS, motor designers have upped the rating of motors having a given set of dimensions as they found ways to increase specific loading without sacrifice of performance. The last step up was taken in 1940. It is not surprising, therefore, that the industry has now announced another advance which puts the 1-hp polyphase motor in a new frame with only 4½ inch shaft height (a size that has heretofore been in the fractional horsepower range), with corresponding changes in the larger motor frames. It is noteworthy, however, that through all 50 years of motor progress, the standard temperature rise has remained at the conservative value of 40 C.

Three recent motor symposia on reactance, on double squirrel-cage designs, and on insulation helped to lay the foundation on which the new step is based, and illustrate the way in which engineers emulate each other in contributing to the advance of the art.

Standard Frame Dimensions

To give motor users freedom in the design of their equipment without fore knowledge of what particular motor may be applied, standard mounting dimensions have been established by N.E.M.A. with shaft heights as given in Table 1. Practically all induction motors in the United States between ⅛ and 125-hp rating are built in one or another of these standard frame sizes.

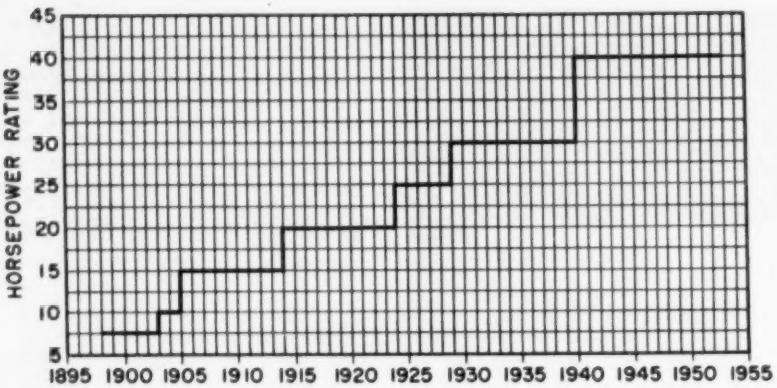
The frame number for a fractional-horsepower motor is equal to 16 times the height from base to center of shaft. Only one frame number for each diameter of these motors is required since the same base and foot dimensions are used for all lengths of frame in the same diameter. For an integral-horsepower motor, the first two digits of the frame number are equal to 4 times the shaft height, while the third digit indicates indirectly the length of frame, or axial distance between the motor feet.

The ratio of successive shaft heights, and, therefore, of frame diameters, averages about 1.15, the ratio being a slightly greater for the small sizes, and a slightly smaller for large ones. Two frame lengths are usually recognized for each height. Since the output obtainable from a homologous series of frames varies roughly as the 4.5 power of the diameter, the ratio of successive horsepower ratings obtainable in the standard dimensions is about $(1.15)^{2.25}$, or 1.37. There is, therefore, a good alignment between standard frames and ratings, assuming that the space available within the frame dimension is utilized to the same degree in all sizes.

The problem of maintaining free competition among manufacturers and steady technical progress in the more efficient use of material, while preserving interchangeability between all makes of motors, poses some very interesting questions of standards and engineering policy. The logic behind the accepted plan of periodically increasing the horsepower assigned to a given frame, one step at a time as technical progress permits, is indicated

TABLE 1 — STANDARD N.E.M.A. MOTOR FRAMES

Shaft Height	Frame number		Diameter of shaft extension		Usual ratings for 60 cps, 3-phase 40 C rise by thermometer 4 poles, 1800 rpm	
	Present (1953)	Proposed (1954-5)	Present (1953)	Proposed (1954-5)	Present (1953)	Proposed (1954-5)
2 5/8 in.	42	—	3/8 in.	—	—	—
3	48	—	1/2	—	—	1/6, 1/4 hp
3 1/2	56	—	5/8	—	1/4, 1/3 hp	1/3, 1/2, 3/4
4 1/8	66	—	3/4	—	1/2, 3/4	—
4 1/2	—	182, 184	—	7/8 in.	—	1, 1 1/2, 2
5	203-4	—	3/4	—	1, 1 1/2	—
5 1/4	—	213, 215	—	1 1/8	—	3, 5
5 1/2	224-5	—	1	—	2, 3	—
6 1/4	254	254, 256	1 1/8	1 3/8	5	7 1/2, 10
7	284	284, 286	1 1/4	1 5/8	7 1/2	15, 20
8	324, 326	—	1 5/8	1 7/8	10, 15	25, 30
9	364-5	—	1 7/8	—	20, 25, 30	—
10	404-5	—	2 1/8	—	40, 50	—
11	444-5	—	2 3/8	—	60, 75	—
12 1/2	504-5	—	2 7/8	—	100, 125	—



Periodic review of industry standards has resulted in this 55-year record of increasingly larger-rated motors being assigned a given frame size.

by a consideration of two possible alternatives.

If the horsepower rating of each frame size were permanently "frozen," manufacturers could take advantage of technical progress by giving greater margins of performance for the same rating using the same amount of active material; or they could keep the same performance margins and shrink the active material, thus saving money.

Alternatives

The first alternative would result in continually higher maximum outputs, higher starting currents, and lower temperature rises for the same horsepower rating. Economics would then force users to employ the motors at continually higher loads with respect to the rating, resulting in more and more overloading. In effect, a motor rated 1 horsepower would then be used as a 1½ hp motor, and so on. All overcurrent protective devices and supply circuits would then have to be adjusted to suit. All ratings would ultimately become indefinite.

The second alternative leads to motors with continually smaller "insides," leaving more and more vacant space inside the mounting dimensions. The economic importance of space makes this unattractive in the long run. A third alternative, the use of nonstandard frames, was given up long ago because of the great value to users of having known and interchangeable mounting dimensions.

Temperature Rise

The temperature of a motor must be limited for several reasons: organic insulations and lubricants deteriorate chemically (as by oxidation) at a rate that doubles for each 8 to 12 C increase in temperature; the resistivity of copper increases linearly with temperature; and the differential thermal expansion of iron, copper, and other materials give rise to mechanical stresses and displacements that cause progressive deterioration. On the basis of insulation deterioration, motor insulations are defined in three major classes: A, B, and H, for which limiting hot-spot temperatures of 105 C, 130 C, and 180 C in continuous service are recognized. The resistance of copper increases in the ratios of 1 to 1.24 to 1.33 to 1.51, as the temperature is increased from 40 to 105 to 130 to 180 C. Thus, a motor designed for the limiting temperature of Class H insulation is handicapped by 22 per cent greater copper resistivity than one similarly designed for Class A insulation.

American Standards

American standards assume a normal ambient temperature not over 40 C, and allow a temperature rise at full load of 50 C by resistance (40 C by thermometer) for a general-purpose motor. A 60 C rise by resistance is allowed for special-purpose motors with Class A insulation, 80 C for Class B, and 120 C for Class H insulation. These values allow for differentials of 5 C, 10 C, and 20 C, respectively, between the hottest spot and the (average) temperature measured by the resistance method.

It is a requirement of the American standards that every general-purpose motor shall operate continuously without injury at an output equal to 115 per cent of its rating. This 1.15 ratio, called the "service factor," provides a margin for unforeseen service conditions. With 60 C rise by resistance as the basic temperature limit for continuous operation and the 1.15 service factor, 50 C rise by resistance becomes the appropriate value for the nameplate rating of a general-purpose motor. This is the same as the 40 C rise by thermometer that has so long been and still is the standard for American motors.

The adjoining graph shows a calculated curve of hot-spot temperature rise versus load in continuous operation for a typical general-purpose induction motor, taking the rise to be 50 C at rated load, and assuming constant resistance. The dotted line, rising more steeply, indicates the effects of temperature creep, or the cumulative rise in temperature caused by the progressive increase in the resistivity of copper as the temperature rises. Temperature rise is assumed proportional to losses. This indicates that a load of 150 per cent of nameplate, or 130 per cent of the service factor rating, will give a hot-spot temperature rise of roughly 110 C in continuous service, or 60 C above normal. Thus, high sustained overloads are rapidly destructive; on the other hand, occasional short-time overloads of moderate value can be tolerated without greatly decreasing the motor life.

In the interests of economy, it is desirable to use a given standard motor for as many applications as possible. Consequently, it is customary to apply general-purpose motors (continuous rated) whenever the peak momentary overloads do not exceed about 75 per cent of the breakdown torque, or when the root-mean-square value of the motor losses over any extended period does not appreciably exceed the losses at the service factor rating, or when the duration of any overload is not long enough to bring the momentary peak temperature above a reasonably safe value—perhaps 75 C rise.

Protection

Assurance that all these limits will be observed is secured in practice by selecting overcurrent protection devices properly timed to permit proper use of torque and thermal abilities, but which cut the motor off the line when either the torque or thermal limit is exceeded. Normally, protective devices cut the motor off when the operating temperature exceeds about 60 C rise. On the other hand, when the motor is stalled at full voltage, and assuming that the locked-rotor current is the normal value of about 600 per cent, the device will not operate until the temperature reaches about 125 C. This generally permits a total stalled time of about 20 seconds.

From this analysis, it is evident that the over-all cost of an open-type motor will not be greatly reduced by merely designing for operation at a higher temperature rise. If a new insulation gave the same life at 20 degrees higher

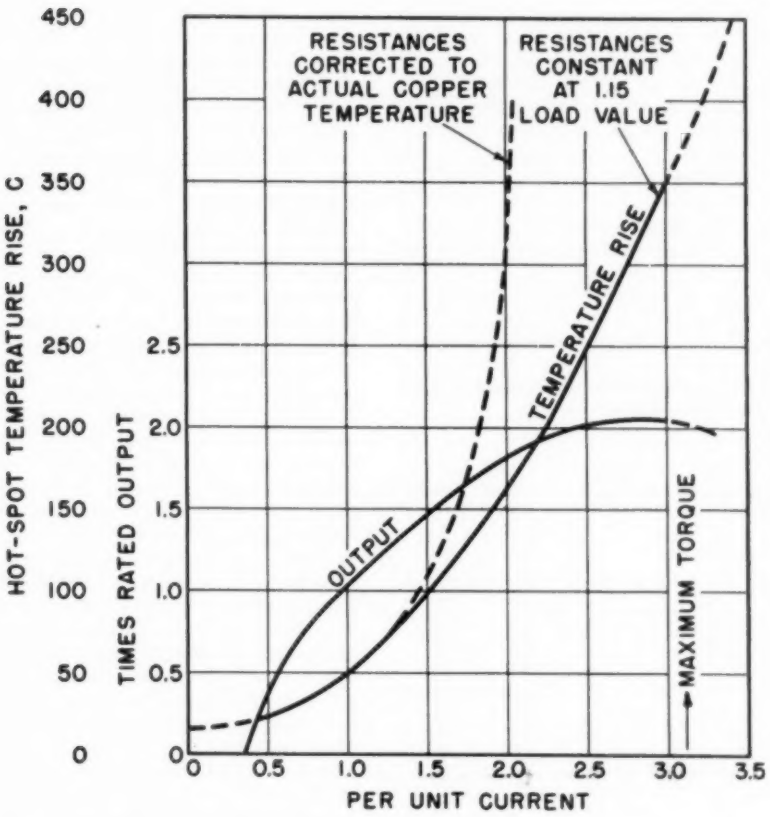
temperature, and the rise at rated load was, therefore, increased from 50 to 70 C, the rise at 1.50 load would then be increased from 110 C to 154 C, (110 x 70 ÷ 50 = 154). It is also necessary to add a few degrees to allow for temperature creep, which gives 50 C more than for the original motor. That is, the overload rise is increased some 30 C more than the rise at rated load, giving an apparent reduction of the life on an overload to only $(\frac{1}{2})^3$, or say 12 per cent, of the original motor's life. Unless the new insulation has a temperature increase for half life materially higher than the 10 C figure, at the same time that its life at normal temperature is improved, the hotter motor will have a materially lower overload capacity. Also, there are knotty problems of bearing design, lubrication, and thermal expansion stresses to be solved; these become progressively more difficult as the temperature rises.

The chief advantage of a motor insulation that can withstand higher temperatures is greater endurance under short-time overloads, as in starting or when stalled. Under high ambient temperatures there are new factors entering the insulation field that may in time modify these conclusions: the advent of a large number of entirely new synthetic materials, and the program for developing functional test codes where motor insulation will be evaluated on the basis of performance in life tests instead of by chemical composition.

Ratings

The purpose of the motor rating is to accurately define the useful range of performance in a way most intelligible to the user and in a way that can be accurately verified by simple test procedures. The performance of mechanical apparatus is normally limited by mechanical considerations in the self-contained unit. The continuous output rating is therefore very little below the maximum momentary capacity. Users do not expect to load such machines appreciably beyond their ratings, even briefly. Electric motors, on the other hand, may carry large short-time overloads. The rating of an induction motor includes five major variables: the supply voltage and frequency, and the motor horsepower, speed, and temperature rise. The rated power together with the rated speed determines the torque the motor can deliver. Beside these factors, the rating specifies the type of service (continuous, intermittent, or varying duty) for which the motor is intended. The rating implies a host of different qualities built into the motor including starting, continuous, and overload torques, temperature endurance, high potential strength, low starting current, and other factors.

Standards are invaluable in the maintenance of a proper variety of motor types and sizes for the fair comparison of competitive designs, and for the economic handling of power supply, control, and installation problems. The selected ratings and mounting dimensions allow motor users and power suppliers to design standard equipment and to carry stock bases, pulleys, fuses, and overload relays with complete assurance that they will fit any standard make of motor. Immense cost and time savings result through increased production of fewer varieties, advance planning, simplified warehouse stocking, and reduced paper work.



Temperature-current curves showing typical characteristics of general-purpose induction motor temperature creep when operating under overload.

General-Purpose Motors

The prime purpose of a motor is to deliver torque. Service reliability and flexibility in application are of major importance; thus American standards require that a polyphase motor for general-purpose use shall have a maximum or breakdown torque not less than 200 per cent of nameplate rating. For single-phase motors, the breakdown torque shall not be less than 175 per cent. Somewhat greater values are specified for motors in the smaller sizes, as given in Table 2.

A "general-purpose motor" is any motor having a continuous 40 C rating designed, listed, and offered in standard ratings with standard operating characteristics. Mechanical construction is specified for use under usual service conditions without restriction to a particular application or type of application.

These motors are designed to operate successfully when the voltage variation does not exceed 10 per cent above or below normal, and when the frequency does not vary more than 5 per cent either way from normal; the sum of the two variations may not exceed 10 per cent at any one time. Usual service conditions are: temperature of the cooling medium is not over 40 C; altitude is not over 3300 feet (1000 meters); surrounding conditions do not interfere with ventilation; and the motor is solidly mounted

with a drive arrangement in accord with good standard practice. The values given are the upper limits of the range of application; i.e., they are the highest the user can rely upon, as well as the lowest the manufacturer must provide.

Breakdown torque of the standard polyphase motor is chosen to be 200 per cent on this basis: it is desired to be certain that the motor will continue to deliver its normal output during temporary periods of low voltage. Under-voltage release or thermal overload protective relays are normally set to take the motor off the line if the current rises above a value roughly corresponding to full load, at 85 per cent of normal voltage. It is highly desirable to have the motor continue to carry its load down to this voltage level. Since the breakdown torque varies as the square of the voltage, this requires the torque at rated voltage be at least 1.38 times the maximum load value.

Every general-purpose motor must be able to operate continuously without injury at the service factor output, nominally equal to 115 per cent of its nameplate rating.

Finally, a factor of about 1.25 is allowed to provide for occasional overloads and unforeseen contingencies in motor operation, and to insure a liberal starting torque with little sacrifice of efficiency. The product of the breakdown torque, service, and overload factors is about 2.0.

Progressively higher starting and breakdown torques are standard for smaller motors for several reasons: loads driven by small motors generally need higher starting torques than those of large motors because of relatively greater friction (as in shaft seals); there are cost limitations on the use of unloaders for small motors; small motors are started more frequently and the inherently large ratio of no-load to full-load current of the smaller motors gives them a smaller per cent increase in current on overload. For example, the line current of a ½-hp single-phase motor will increase to only about 1.5 times rated value at twice its rated torque, whereas the corresponding factor is about 2 for a three-phase motor of 20 horsepower or larger. This means that a greater percentage overload can be carried by a small single-phase motor than by a large polyphase motor, for a given increase in temperature rise. Along with the greater breakdown torque values, and for the same reasons, the service factors for the small motors are increased above the 1.15 standard for the larger motors as shown in Table 3 on page 79.

It is assumed that general-purpose motors will be started at full voltage. Under this condition, the torques provided will bring any usual load up to full speed within 10 to 15 seconds or less, and yet will not be high enough to overstress the shaft or couplings. The torque being reduced as the square of the voltage, only loads requiring relatively low torque can be started with reduced voltage starting. In general, any increase in the allowable starting current allows a lower secondary resistance to be used, giving a higher operating efficiency for a given starting ability.

The starting current of a motor causes a dip in the supply voltage, and it also determines the requirements for overcurrent protection devices. To avoid ambiguity and to facilitate measurement, the term "locked-rotor current" is used for all guaranteed values in place of the loosely-defined term "starting current." It is desirable from the user's viewpoint to hold this current as low as possible but this handicaps the designer. The presently accepted values, given in Table 3, are a compromise between the needs of the power supplier, the user, and the designer.

The ratio of per cent starting current to per cent breakdown torque is nearly constant for any type of induction machine, and is a little greater than 2 for usual polyphase motors. Therefore, a per unit breakdown torque of 2 plus requires a per unit locked-rotor current of somewhat more than 5. The current values given in Table 3, are, therefore, in close accord with the torque values as illustrated in Table 2.

TABLE 2 — LOCKED ROTOR AND BREAKDOWN TORQUES OF THREE-PHASE GENERAL-PURPOSE MOTORS (PER CENT OF FULL-LOAD TORQUE)

Synchronous speed	3600 rpm		1800 rpm		1200 rpm		900 rpm	
Torque	Breakdown	Locked rotor	Breakdown	Locked rotor	Breakdown	Locked rotor	Breakdown	Locked rotor
½ rated hp	*350 %	—	*325 %	—	*300 %	—	250 %	175 %
¾	*325	—	*300	—	275	175 %	250	175
1	*325	—	300	275 %	275	175	250	175
1½	275	175%	300	265	275	175	250	175
2	250	175	275	250	250	175	225	175
3	250	175	275	250	250	175	225	175
5	225	150	225	185	225	160	225	130
7½	215	150	215	175	215	150	215	125
10	200	150	200	175	200	150	200	125
15	200	150	200	165	200	140	200	125
20, 25, 30	200	150	200	150	200	135	200	125
40	200	135	200	150	200	135	200	125
50, 60	200	125	200	150	200	135	200	125
75	200	110	200	150	200	135	200	125
100	200	110	200	125	200	125	200	125
125, 150	200	100	200	110	200	125	200	125
200	200	100	200	100	200	125	200	125

*Approximate

Special-Purpose Motors

The philosophy of the American standards is to recommend a limited number of standard designs and to require that motors so rated shall strictly adhere to the standard guarantees. At the same time, wide freedom for use of other motor types at the option of the manufacturer or the user is to be possible so long as such motors are distinguished by clearly defined ratings.

A special-purpose motor is a motor with special operating characteristics or special mechanical construction, or both. It is designed for a particular application not falling within the definition of a general-purpose or definite-purpose motor. A definite-purpose motor is any motor designed, listed, or offered in standard ratings with standard operating characteristics or mechanical construction for service conditions other than usual, or for a particular type of application.

Polyphase squirrel-cage motors are classified under five design letters: A, B, C, D, and F, having different torque and current values. The Design A motor is, in a squirrel-cage motor, designed to withstand full-voltage starting, which develops a locked-rotor torque not less than, and a breakdown torque greater than, those given in Table 2; slip at rated load must be less than 5 per cent; and the locked-rotor current must be higher than that given in Table 3.

These high-starting-current designs are limited to services where it is imperative to have unusually low values of copper loss for efficiency or heating reasons. In the totally enclosed,

TABLE 3 — SERVICE FACTORS AND LOCKED-ROTOR CURRENTS OF THREE-PHASE GENERAL-PURPOSE MOTORS

Rated horsepower	Service factor	Locked-rotor current at 220 v, 60 cps, 3-phase
1/8 and less	1.40	24 amp/hp
1/6	1.35	4 amp
1/4	1.35	6
1/3	1.35	8
1/2	1.25	12
3/4	1.25	18
1	1.25	24
1 1/2	1.20	35
2	1.20	45
3	1.15	60
5	1.15	90
7 1/2	1.15	120
10	1.15	150
15	1.15	220
20 and up	1.15	14.5 amp/hp

fan-cooled motors, for example, cost and application make it desirable to keep the same frame size as for the open motors of the same ratings. To accomplish this, it is sometimes necessary to use a reduced number of stator winding turns, so obtaining a lower resistance at the expense of a lower reactance and, therefore, a high starting current.

Design B motors are similar to Design A, except that they have breakdown torques not less than those given in Table 2, and starting current values not exceeding those given in Table 3. The general-purpose motors come in this category.

Design C motors have higher locked-rotor and lower breakdown torques than A or B, as given in Table 4, but have locked-rotor current values the same as Design B motors (Tables 2 and 3), and a slip at rated load of less than 5 per cent. These motors are designed with double squirrel cages or equivalent rotor construction, and are used for applications requiring high breakaway torque or rapid acceleration.

Design D motors have locked-rotor torques of 275 per cent rated torque with locked-rotor currents in accord with Table 3, and have a slip at rated load of 5 per cent or more. These motors have high-resistance rotor windings and are used for loads having high inertia or requiring frequent starting or reversing. They are also useful for driving intermittent loads, such as punch presses, where the stored energy in a flywheel supplies part of the torque peaks.

Design F motors (rated 30 horsepower and larger) have locked-rotor torques of 125 per cent and breakdown torques of 135 per cent of their rated values, with a locked-rotor current of only 9 amperes per horsepower. These have very limited applications.

Motors are also classified according to their mechanical protection and methods of cooling. The American standards define open, drip-proof, splash-proof, semi-protected, protected, fully protected, totally enclosed non-ventilated, totally enclosed fan-cooled, explosion-proof, dust-explosion-proof, water-proof, and pipe-ventilated machines. Each type has its own field of usefulness. Every effort is made to apply either the open (normally built to be substantially drip-proof) or the totally enclosed fan-cooled design in preference to the others. These two types are in highest production and, therefore, cost least and are most readily available.

Of these types, only the open general-purpose motor has a 40 C rating with service factor (Table 3). Other open and drip-proof, special-purpose, Class A insulated motors have a 50 C rating (with 1.0 service factor); the totally enclosed types have a 55 C rating by thermometer (or 60 C by resistance).

A third classification of motors is in accordance with the duty cycle. General-purpose motors have a single "continuous" rating, and are designed for steady operation at rated load for an indefinite period of days or even years without shutdown. For loads requiring repeated short-time operation, motors with short-time ratings of 5, 15, 30, or 60 minutes are available. A 30-minute rated motor, for example, will normally have the same torques, locked rotor currents, and temperature rise ratings as the comparable continuous-rated motor, but its temperature rise will exceed the standard value if the rated-load operation continues beyond the specified 30-minute period, or if this load cycle is repeated too often. The short-time rating gives no information on the permissible repetition frequency of the load cycle; this depends on the balance between the losses and the heat-storage capacity of the motor and upon the rate of cooling.

For loads requiring continuous operation at reduced speeds and for the most severe starting duty, wound-rotor motors with external rheostats are employed; multi-speed motors with pole changing can be used. Very large motors, in ratings of more than 500 horsepower, are generally wound-rotor construction to provide easily controlled starting with low starting current.

Large wound-rotor motors may be provided with an auxiliary commutator machine on the motor shaft (Scherbius or Kramer system) which supplies a slip-frequency voltage to the rotor. In this way, the motor speed can be adjusted to any desired value without loss of efficiency, the slip losses being returned to the line or the shaft through the commutator machine. Only a moderate departure from normal motor speed is feasible as cost and performance of the commutator machine rapidly become less favorable as the slip frequency increases.

All these motor types can be provided with open, protected, or enclosed construction; with or without gears, brakes, or clutches; and in vertical or horizontal mountings. Innumerable modifications and combinations of such motors can be provided with special control to take care of almost any conceivable cycle of speed and torque variations.

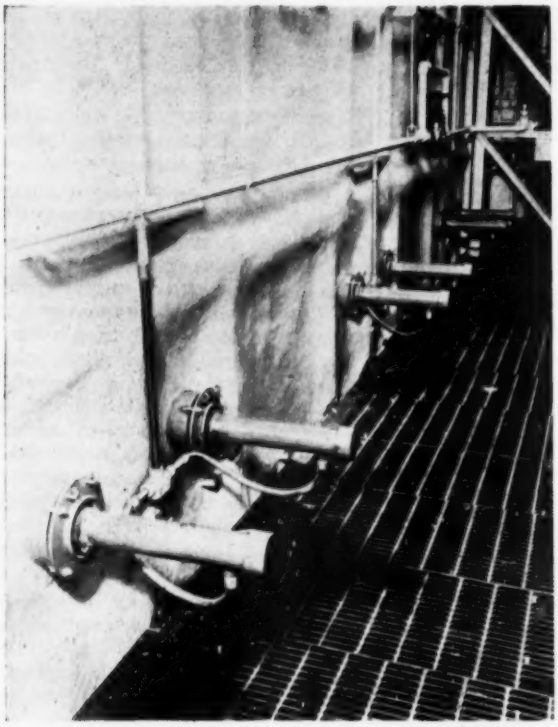
Conclusion

The polyphase induction motor is the industrial electric motor with lower cost, greater reliability, and more adaptability than any other so long as reasonably high speed and predominantly constant speed performance in moderate power ratings are desired. It gives way to the direct current machine when very low speeds, frequent reversing, or high accelerating torques are wanted. It is excelled by the synchronous machine for power generation, largest powers, and for drives at low and constant speed.

For ratings below one horsepower, a single-phase power supply is generally more economical; in this very extensive fractional horsepower motor field, the single-phase induction motor predominates.

TABLE 4 — BREAKDOWN AND LOCKED-ROTOR TORQUES OF DESIGN C SQUIRREL-CAGE MOTORS (PER CENT OF FULL-LOAD TORQUE)

Synchronous speed	1800 rpm		1200 rpm		900 rpm	
Torque	Breakdown	Locked rotor	Breakdown	Locked rotor	Breakdown	Locked rotor
3 rated hp	—	—	225	250	200	225
5	200	250	200	250	200	225
7½, 10	190	250	190	225	190	200
15	190	225	190	200	190	200
20 and up	190	200	190	200	190	200



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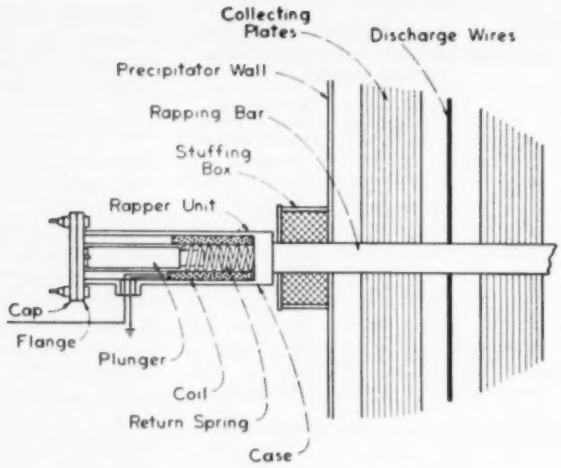


Fig. 1.—A schematic diagram of the individual rapper unit installation.

The same MI rapper unit shown on an actual installation.

New Cleaning Method for Electrostatic Precipitators

Cleaner stack discharges around the clock — improved efficiencies and lower operating costs by using continuous electrode rapping system.

R. W. McCANDLISH and H. S. BAUMGARDNER
Research Corporation

ADAPTION of a pulse generator to electrode rapping for standard fly ash electrostatic precipitators has brought an important revision in electrode cleaning methods. Prior to this development electrode cleaning was mostly done with pneumatic and mechanical rapping systems. Advantages inherent in the new method have warranted change-overs by many power plants, and most new plants now under construction will begin precipitator operation with the new rapping system.

Electrode rapping is an essential part of fly ash precipitator operation, since it serves as the only convenient method of removing insulating dust accumulations from charged electrode surfaces. Disadvantages associated with intermittent rapping have compelled both precipitator users and manufacturers to seek a continuous rapping system which could be easily installed to replace existing equipment and which would not entail higher than present costs for operation, installation and maintenance.

By adapting electrical pulse energy for the purpose, all former obstacles have been cleared to make continuous electrode rapping a practical and economical method.

Clean stack discharges around the clock, improved basic efficiencies for existing precipitators, and lower overall precipitator operating costs are benefits gained from continuous electrode rapping. Other benefits include easier maintenance of the rapping system and automatic operation and control from any convenient location.

Rapping methods and electrode arrangements for cleaning purposes are influencing factors in over-all precipitator performance. Basic electrode arrangement of a Cottrell precipitator for fly ash and other dry dust applications consists of a series of plate-type collector electrodes encased in a shell to form ducts for gas passages. The high tension discharge electrodes are suspended in the centers of the ducts from an insulated framework.

Treated gas flows through an electrical field exerted between these two sets of electrodes in the ducts. Dust particles suspended in the gas receive a uni-polar charge and are attracted to the grounded, collecting plate electrodes of the opposite polarity. Although much of the collected material falls by gravity into dust hoppers below the electrodes, enough of it accumulates on the electrodes to hinder their work.

In most conventional systems, pneumatic or mechanical rappers vibrate the

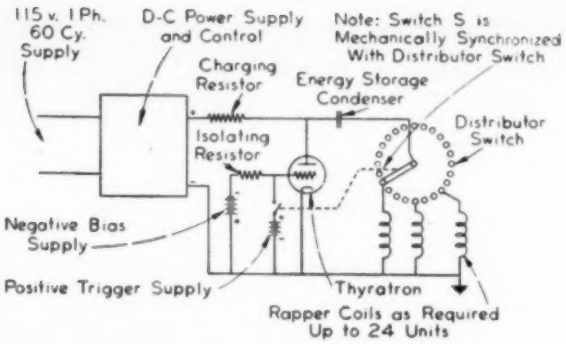
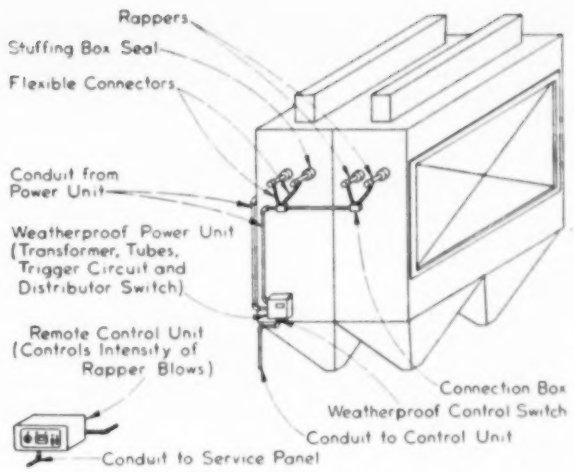

115 v. 1 Ph. 60 Cy. Supply
D-C Power Supply and Control
Note: Switch S is Mechanically Synchronized With Distributor Switch
Charging Resistor
Energy Storage Condenser
Isolating Resistor
Distributor Switch
Negative Bias Supply
Positive Trigger Supply
Thyratron
Rapper Coils as Required Up to 24 Units

Fig. 2.—Circuit schematic for a pulse energy system for electrode rapping.

Fig. 3.—This illustrates the wiring schematic for the MI rapper.


Rappers
Stuffing Box Seal
Flexible Connectors
Conduit from Power Unit
Weatherproof Power Unit (Transformer, Tubes, Trigger Circuit and Distributor Switch)
Remote Control Unit (Controls Intensity of Rapper Blows)
Connection Box
Weatherproof Control Switch
Conduit to Control Unit
Conduit to Service Panel

electrodes at irregular intervals to loosen the accumulations. Electrode cleaning as practiced under intermittent rapping conditions, therefore, is a batch removal process that creates major dust disturbances in the precipitator and hoppers. During such disturbances, large batches of dust move downward in the ducts and fall into the hoppers, and this dust can be re-entrained in the flue gas and escape to the atmosphere.

Various schemes are applied in trying to prevent such dust losses, or rapping puffs, as they are commonly called. They include plate electrodes of expedient designs, various electrode arrangements for rapping, and the closing of dampers during rapping periods. But these schemes, like all others, are only partially effective and cannot with any reliability prevent undesirable dust losses through the stack.

Another obvious disadvantage of intermittent rapping is the possibility that the work capacity of the electrodes diminishes between rapping periods. Despite periodically reduced efficiencies, the over-all gas cleaning capacity of electrostatic equipment is still relatively greater than other types of equipment now on the market.

With continuous electrode rapping the precipitator can be held constantly to maximum cleaning efficiency. Field reports from commercial installations indicate that the basic rated efficiency of a precipitator is improved with this method of rapping.

Pulse generators adapted to electrode rapping functions have none of the limitations that restrict older methods to intermittent rapping practice. Unlike pneumatic and mechanical rapping systems, they can supply electrical pulse energy in required light and easily controlled intensities for continuous rapping conditions. Heavier intensities are also available when thorough cleaning in a short time is needed for precipitator inspections and other purposes of control.

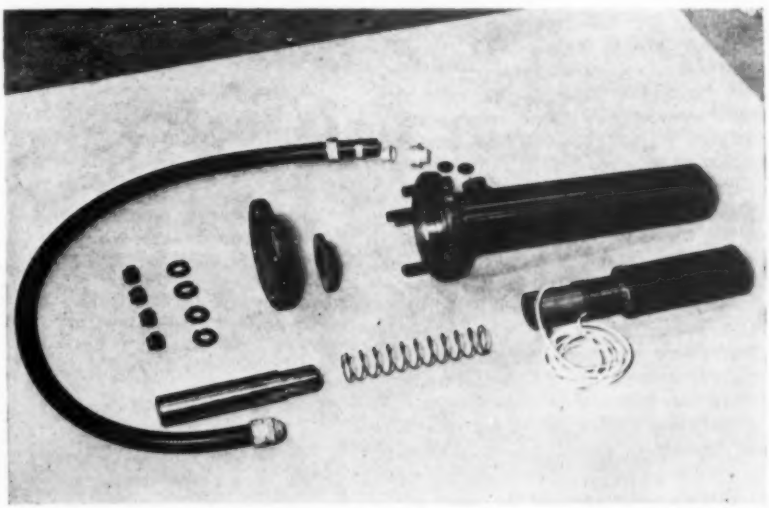
Magnetic-type rappers are used in this impulse rapping system. Energy for up to 24 individual rapping units can be supplied from one central pulse generator without overload.

Electrode arrangement for continuous rapping consists of a number of sectionalized banks. Each bank is rapped in sequence with a fast rapping cycle of a minute or less for the entire precipitator. Rappers for both plate and high tension electrodes are operated from the same power supply source. With this arrangement and rapping method, electrode cleaning becomes a continuous, uniform process.

Under these conditions, rapped dust falls in small, isolated patches and is easily re-precipitated if portions are swept up in the gas stream. And, the amount of dust falling at any time in the ducts and hoppers is too small to create disturbances. Re-entrainment and rapping puffs are thus effectively prevented at the source.

From the standpoint of more efficient and economical precipitator operation, field tests and subsequent commercial installations have proven the superiority of continuous, MI (magnetic-impulse), rapping systems. The MI rapping system can be installed for electrostatic precipitators in cement, gypsum, open hearth furnace, electric furnace, cupola, iron ore sintering, and power generating applications.

Two basic components are employed: the power and control unit, and the individual rapper unit. The rapper unit is a solenoid electromag-



Research Corp.

The complete elements of the rapper unit: solenoid electromagnet, steel plunger, spring, case, rapper bar, flange, cable, assorted hardware, and wire.

net consisting of a steel plunger held in normal position by a steel spring and surrounded by a concentric coil—all enclosed in a hermetically sealed steel case welded to the end of a rapper bar protruding through the precipitator shell and horizontally connecting a group, or bank, of collecting plate electrodes shown in Fig. 1.

When each magnetic coil is consecutively energized by a short current pulse supplied from the power and control unit, the plunger is driven rapidly against the rapper bar, thereby producing the necessary shock vibrations to dislodge the dust accumulated on the plates of the precipitator.

Circuits of this pulse generator and control unit are similar to those developed during World War II for radar applications. Operation of a pulse energy system for electrode rapping is illustrated by the circuit schematic shown in Fig. 2.

Capacitor C is charged through resistance R from a variable d-c power supply consisting of a transformer and a full-wave rectifier. Thyratron tube V acts as a controlled switch to discharge the condenser energy through the solenoid rapper coil. The distributor switch functions merely to connect consecutively each rapper coil in the circuit preparatory to each discharge of condenser C and it does not make or break any current. The construction is such that one contact is always made to provide a closed circuit for the condenser recharging current.

The thyratron is fired by the momentary applications of a positive grid voltage controlled by switch S, which is automatically synchronized with the proper positions of the distributor switch. Both the rectifier tubes and the thyratron are filled with Xenon gas and are therefore unaffected by ambient temperature variations. By means of controlled impulse energization, very high peak plunger energies can be obtained with standard commercial components and low average power consumption.

Frequency of rapping is controlled by the circuit constants and the speed of the distributor switch. These may be adjusted to suit the particular installation, which may involve as many as 24 rapping units operating from the same power supply. With a typical rate of one rap every five seconds, a large precipitator having 12 rapper units would thus have one-twelfth of the total collecting surface rapped once every five seconds, or a complete precipitator rapping cycle of 60 seconds.

Various rappers can be energized in any desired sequence, alternating, for example, between the two parallel units commonly comprising large precipitators. The rapping intensity is remotely controlled and is smoothly adjustable from zero to maximum by means of a simple dial setting which regulates the primary voltage input to the power transformer. Optimum rapping intensities are maintained over long periods of time without maintenance to assure stable performance.

Operation of the entire system and its equipment is fully automatic, and its maintenance requires only a minimum of attention. The rapper units are permanently lubricated at the time of manufacture and contain only one major moving part, which is hermetically sealed against dirt, moisture, and corrosive atmospheres. The units are easily installed in place of existing rapping devices.

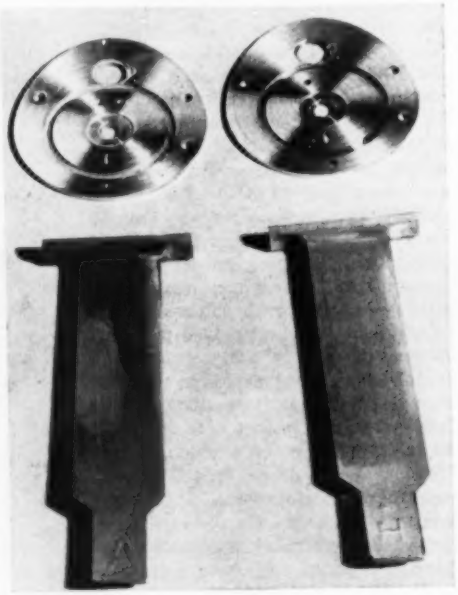
Utrasonic Cleaning Equipment Uses Transducer Element

A practical method of metal cleaning through the use of ultrasonic waves has been developed. The process, known as Soniclean, incorporates a transducer element in place of the quartz crystals previously used in ultrasonic experiments. According to the manufacturer, Detrex Corp., the new element overcomes the limitations caused by size and properties of quartz.

The element, jointly engineered by Detrex and the Brush Electronic Co., is a curved piece of ceramic resembling a 6 in. long pipe, cut in half along the longitudinal axis. The ceramic pieces can be connected in series and arranged to provide focusing as required. The sound waves converge in a straight line equal to the length of the elements.

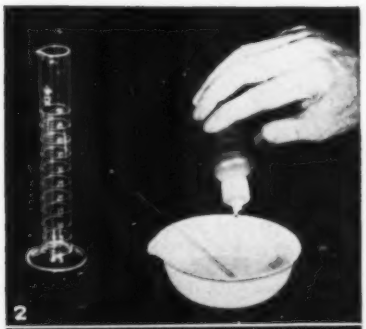
Electrical energy is transmitted to the transducer, converted into sound energy, and projected through a solvent at a frequency of 430,000 cycles per second. The solvent currently being used is trichlorethylene.

Material to be cleaned is placed in the solvent directly in the path of the greatest focal intensity of ultrasonic waves. In this area an extreme turbulence is created, resulting in a deep penetrating cleaning action that almost instantaneously removes all dirt, grease, and chips from the most intricately designed parts.



End plate at top left has a film of hard-to-remove brass dust. Ultrasonic energy cleaned it almost instantaneously. Iron oxide paste on jet engine blade (left) was removed by the new process.

New method is extremely accurate. Procedure requires only four steps: 1—Measured sample is poured into porcelain dish.



2—Buffer solution is added and well mixed with test sample.

3—Indicator is added and mixed with the solution, turning it red.

Simplify your

Water Hardness Testing

DR. GEROLD SCHWARZENBACH, noted Swiss scientist and professor of chemistry at the University of Zurich, has developed new water hardness testing methods that have gained widespread use in this country during the past few years. Associated with the Swiss firm Chemische Fabrik Uetikon in this development, he is credited with revolutionizing test procedures for determining water hardness.

This method for total hardness determination has proven rapid, simple, and accurate within 1 ppm, compared with the century-old "soap-shaking" method which is slow, cumbersome, and involves considerable subjective judgment. Furthermore, Hall Laboratories, Inc., engineering consultants on industrial water problems, have worked out modified procedures, reagents, and equipment which make the basic Schwarzenbach methods convenient for conducting hardness tests in the field.

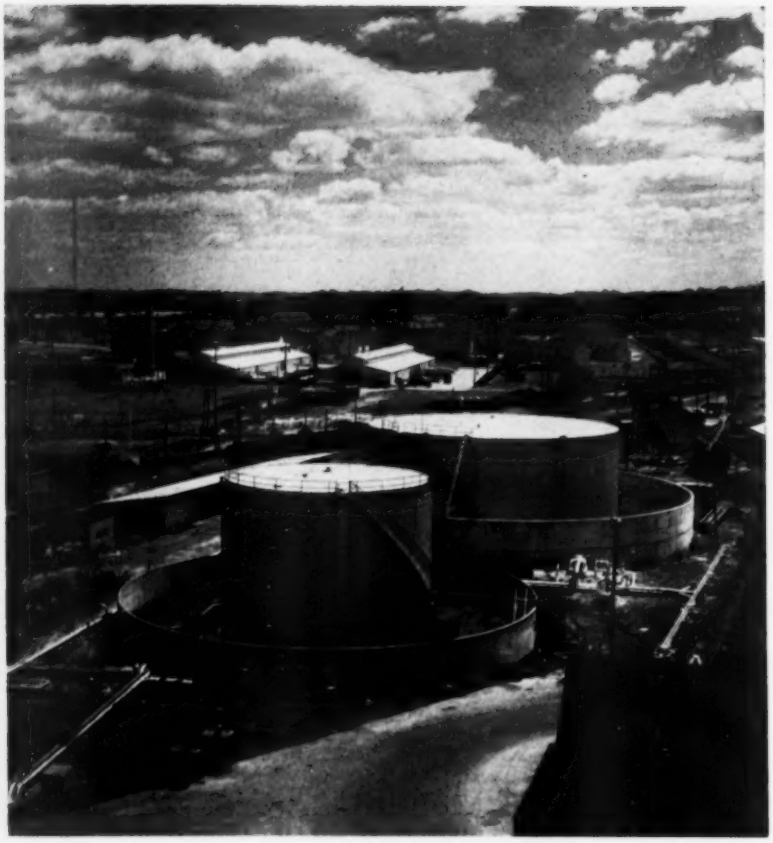
Both total hardness and hardness due to calcium alone can be determined quickly and precisely by the new test methods. Magnesium can be determined by difference. The method for total hardness is especially sensitive to small amounts. Without special precautions 1 ppm of hardness as $CaCO_3$ is detected, and with special techniques and more dilute titrating solutions, even lower concentrations can be determined.

The endpoint of a test for total hardness is sharp and readily detected so that the "human factor" which made the old soap-shaking method unreliable is practically eliminated in the new Schwarzenbach test.

There is no limitation on sample size, other than economy of operation, since no scum or salt effect can obscure the endpoint. The new methods can be applied to high or low hardness, even in fairly concentrated brines, and thus are gaining broad use in industry, public and private steam generating plants, marine applications, and elsewhere.

4—Titration turns the solution color to bluish at the endpoint.

Further information on these tests is available from Hagan Corporation and its associates, Hall Laboratories, Inc., Calgon, Inc., and The Buromin Company, 323 Fourth Avenue, Pittsburgh 22, Pa.



LEFT

These two tanks store 60,000 bbl of No. 6 fuel oil for firing four boilers that supply steam to generators with a capacity of 18,000 kw. Two additional boilers, serving 140,000 kw generators, are equipped with oil and coal burners and also draw from the tanks. Both the tanks are equipped with foam fire extinguishing systems.

CENTER

Water-foam solution is pumped from the control house and up the pipe to the foam making chamber. Here air is introduced to expand the volume of mixture about ten times.

RIGHT

Carbon dioxide portables are provided for all electrical equipment. Class C (electrical) fires are readily extinguished with this cold, inert gas.

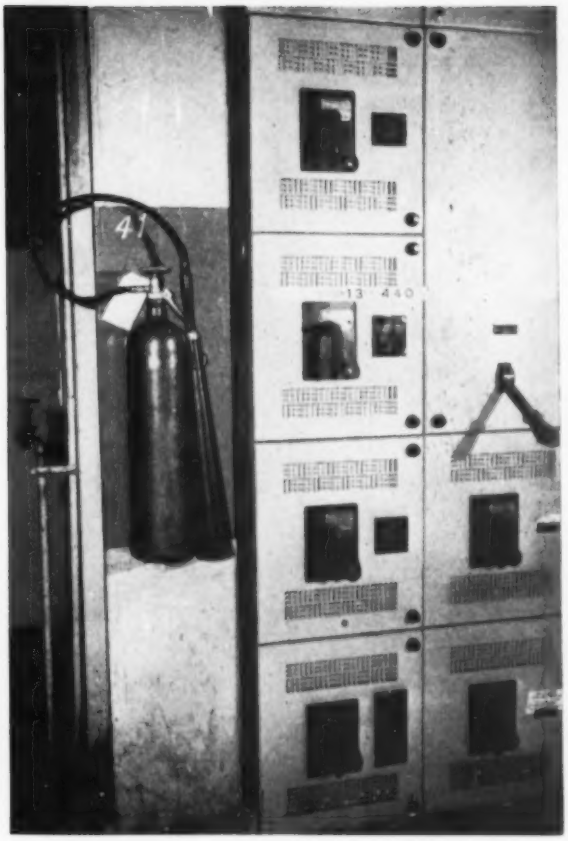
Potomac Electric Protects Fuel

Interior of the small foam system control house contains motors, pumps, foam solution tank, and valving-piping arrangements. Operation of the entire system is outlined on a conspicuously mounted instruction chart.

MAINTAINING electrical power for any community is important, but the flow of electricity for the nation's capitol, is vital. Potomac Electric Power Co., the public utility serving metropolitan Washington, D. C., is keenly aware of this responsibility and has taken prudent steps to safeguard its plant against damage.

A recent safety move by Potomac at its Benning Station was the installation of foam fire extinguishing equipment to protect the oil tanks. The two tanks store number six fuel oil, have a combined capacity of 60,000 bbl, and are located approximately in the center of Benning's 70 acre tract.

Loss of the oil storage reservoir would not seriously curtail Benning's 260,000 kw capacity under normal conditions as only four boilers, supplying steam for a generator capacity of 18,000 kw, are oil fired. However, under certain coal shortage conditions, two large boilers, equipped to burn



Oil Tank Farm With Foam System

either coal or oil and supplying 140,000 kw capacity turbo-generators would be affected. In such a likely situation, the plant's capacity could be reduced substantially.

Of further concern to Potomac's management was the protection of the tank farm, which involves an investment of over $250,000. Another consideration was the possibility of a severe tank farm fire spreading to other structures on the property.

To guard against these dangers, Potomac had a foam fire extinguishing system* installed for the two tanks. The system, operated from a small foam house, draws water from municipal water mains. (Valving permits substitution of Anacostia River water if necessary.) An electric pump boosts water pressure to 130 psi at 636 gpm. A positive displacement pump draws foam compound from a 500 gal tank and introduces it into the water stream to form a 3 per cent solution.

The mixture of water and compound is piped to a solution distribution header in the foam house that has valved lines leading to each tank and the foam hydrant main. Depending on which header valve is opened, the water-foam solution passes to a foam making chamber where air is drawn into the mixture. In the case of the hydrants, air is introduced at the hose nozzle. Introduction of air expands the mixture about 10 to 1 and creates fire-killing foam.

Foam is conveyed into the tank through foam chambers. The larger tank (45,000 bbl) has on its top two foam chambers, each of which is equipped with a coiled, asbestos tube. In event of a fire inside the tank, foam pressure forces the tubes to uncoil and drop to the surface of the oil where they float and deliver the foam smoothly across the surface of the burning liquid. The chamber for the smaller tank (15,000 bbl) has an internal deflector, which directs the flow of foam against the interior of the tank shell in such a way as to avoid the submergence of the foam and minimize agitation of the burning surface.

Operation of the system is simple. Full directions are outlined in simple 1, 2, 3 steps on a conspicuous wall chart in the foam house. Similarly, all valves are clearly labeled. One man throws the electric pump control switches to "on," opens the main water supply valve, and opens the proper valves on the solution distribution header. A proper rate of compound flow is fixed by opening the recirculating by-pass valves. The foam floods to the foam makers, is introduced into the tanks, and spreads evenly over the surface of the burning liquid. Blanketing the surface of the oil with foam cuts off oxygen to smother the blaze.

Every precaution has been taken by Potomac to minimize the possibility of a tank farm fire.

The Bahnson Co.

Unit system provides supersaturated air required to maintain proper relative humidity in this rayon weaving room.

The Bahnson Co.

Central station system in cotton spinning room has atomizers mounted at discharge grills for additional evaporation.

Air Conditioning Plays Important Role in Textile Industry

FRANCIS A. WESTBROOK

AIR CONDITIONING in the textile industry has progressed very rapidly since the advent of synthetic fibers. Unless reasonably uniform atmospheric conditions are maintained, many irregularities are liable to occur, and the quality of the work cannot be relied upon. In fact many of the methods of processing synthetic yarns are not practicable without air conditioning. Advantages of air conditioning in cotton and woolen mills are so great that progressive management is installing it in a great many instances.

Practice of adding moisture to the atmosphere in certain departments of textile mills, such as weaving and spinning rooms, has been carried on for a long time. In the early days, mills were purposely located in river valleys or other places where the air was naturally damp. However, the old methods did not provide for the control necessary for the new fibers and the high speed production of the modern mill, and at best the conditions were largely at the mercy of the vagaries of the weather.

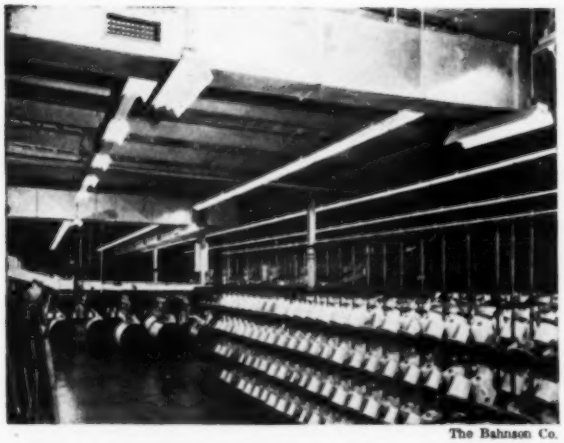
One large concern, which manufactures a wide variety of fabrics, has found that it cannot operate without properly functioning air conditioning. For example, the Jacquard looms are troublesome when the humidity varies, because the length of the cords changes and causes poor cloth.

Another textile mill, which throws nylon yarn, uses air conditioning to control the evaporation of sizing and drying by maintaining a constant temperature and relative humidity the year around regardless of outside weather conditions. In those departments where twisting, coning, and spooling are carried on a constant, somewhat higher, relative humidity is maintained, but the temperature is permitted to vary somewhat. In other words there are conditions where constant temperature and relative humidity should be maintained, and others where constant relative humidity, with not too great varying temperature, is sufficient.

At this point it might be well to refresh the memory as to just what relative humidity means. Briefly, air always contains some water vapor. Absolute humidity is the weight of this water per cubic foot or air at a specific temperature and pressure (generally atmospheric pressure is assumed and not mentioned). The capacity of air to hold water varies with its temperature, warm air having the ability to hold more water than cold air. Relative humidity refers to the amount of water in the air compared to the maximum it can hold when saturated at a given temperature.

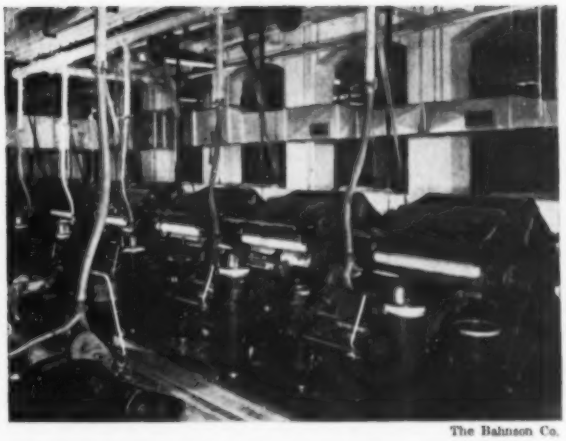
Thus if the relative humidity is 50 per cent at 84 F, the air has only half the total amount of moisture it can carry at that temperature. Due to the fact that warm air can hold more moisture at a higher temperature we find that at 32 F it holds only one-seventh as much as at 90 F with the same relative humidity at both temperatures.

Consequently if cold outside air, say at 32 F and 70 per cent relative humidity is brought into a heated room, its relative humidity is sharply decreased, although the amount of moisture in it remains the same. At the higher temperature and corresponding low humidity, the air tends to absorb moisture from objects in the room with the result that they become dry. Therefore in winter, heated air must have moisture added by means of humidifiers and, conversely, in summer it may be necessary to remove moisture by means of dehumidifiers if constant relative humidity is to be maintained.



The Bahnson Co.

Central station system provides uniform conditions the year around in twisting room of this synthetic weaving mill.



The Bahnson Co.

Carefully planned distribution of air is necessary to provide best operating conditions in this cotton carding room.

In addition to the influence of outside weather conditions there are several inside factors, which affect the temperature and relative humidity. These vary in different mills and in different departments of the same mill.

Motors driving the machinery affect the temperature depending on how many there are in operation, their size, and location. The number of people in a room also affects the temperature and humidity. Exposure to sunlight is likely to heat the sunny side of the room so as to create local warm spots, which affect the relative humidity at those points, and cause unbalance unless the air is kept in circulation. Adequate circulation also prevents stratification of the air at different levels and maintains the necessary conditions at the work by maintaining uniform temperature and relative humidiy in all parts of the room. In this way irregularities in quality and quantity of production can be avoided.

One method of air conditioning is the unit system in which each unit has an axial flow fan, a motor-driven centrifugal evaporator, cooling coils when refrigeration is required, and heating coils. There is an intake to mix recirculated air with fresh air, which is provided through automatically controlled dampers and air filters. All this equipment is compactly placed at the intake end of the distribution duct extending into the room. A given room may have a number of these units to meet all the conditions.

A fine spray is produced by the evaporator. This is partially evaporated in the duct. The remainder, in the form of entrained moisture, passes through the outlets of the duct and evaporates in the room, which provides additional evaporative cooling.

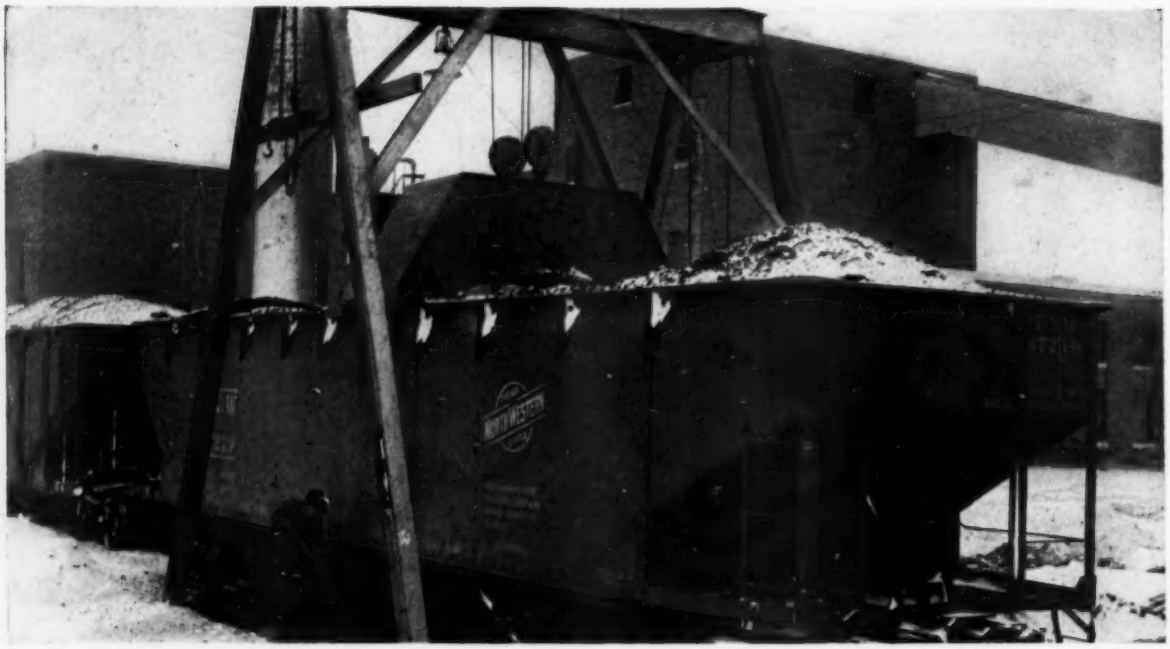
The manufacturer, previously referred to that throws nylon yarn for weaving and hosiery, has units of this type in the room where the sized yarn is dried. They are equipped with cooling coils, or refrigeration, to maintain the desired temperature in summer and with heating coils for winter conditions. In the twisting, coning, and spooling departments the units are evaporative coolers in summer and heating coils in winter.

Another method of air conditioning is the central station or air washer system. In this method there is one central conditioning installation with ductwork serving a whole room or area. This system is most suitable where relative humidities in the medium range, usually not exceeding 55 or 60 per cent, are to be maintained. The limitation as to the degree of relative humidity is due to the fact that the central system supplies only saturated air at best, the distribution ductwork not being capable of handling supersaturated air. The unit system, on the other hand, can evaporate much more water on account of the mist it expels into the room, and thus maintain higher relative humidities while handling the same volume of air.

In cases where the central system is to be installed, and it is desired to provide the higher relative humidities, the usual practice is to place pneumatic atomizers at the air outlets of the ductwork. For example the weave shed of one of the synthetics manufacturers, to which reference has been made, has four central systems for the complete control of the four zones into which the building is divided. One of the systems does not have any atomizers because the required relative humidity is not too high, but the others all have varying numbers of atomizers for supplementary evaporation.

Special considerations must be met in many cases by special treatment. For example the extensive amount of heat generated by the motors in cotton and spinning rooms must be taken into account when designing the air conditioning installation. It calls for handling large quantities of moist air, which must be uniformly circulated so that conditions will be constant throughout the space. In card rooms, circulation of the air is very necessary so that the atmosphere in all parts of the room will be uniform, but it is particularly necessary that the air flow be very gentle as anything like a draft cannot be tolerated.

Extent to which relative humidity is varied may be seen by the conditions maintained in a southern cotton mill. The card room is maintained at 50 per cent relative humidity with a maximum temperature of 89 F. Conditioning is by means of a central system, and no atomizers are used because the humidity is not high enough to require them. In the spinning room the relative humidity is held at 60 per cent wth a maximum temperature of 87 F in the room. This also is accomplished without the use of atomizers. In the weave room, however, it is desirable to keep the relative humidity at 85 per cent to get the best results, and atomizers are used with the central air conditioning system in service. This provides for evaporative cooling, which will hold the room temperature down to 79 F even if the outside temperature is up to 96 F. Such systems may be designed for refrigeration, and often are, so that the inside temperature may be kept within comfortable limits. Automatic controls can also be provided.



Allis-Chalmers

Overhead mounted, mechanically driven car shaker being used to unload coal at a central power plant.

Hopper Cars Take a Good Shaking

T. S. ABBOTT
Allis-Chalmers Mfg. Co.

A mechanical car shaker facilitates unloading of bulk material, eliminates use of manual labor, and effects savings in operation and maintenance costs.

HOPPER CARS for transporting bulk material in industry are practically all built with the steel plate floor (slope sheet) slanted at an angle of 30 deg to the horizontal. Bulk materials, with an angle of slide of 30 deg or less, will slide out of the hopper car under the influence of gravity under ideal conditions. Materials that have a slide angle greater than 30 deg will only flow out of the car until the angle between the horizontal and the top surface of the material is equal to the angle of slide. The remaining material in the space between the top surface of the material and the 30 deg steel plate floor will require some externally applied force to cause it to flow from the car.

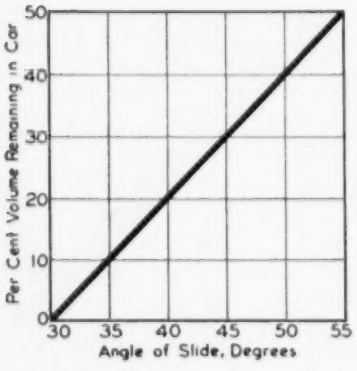
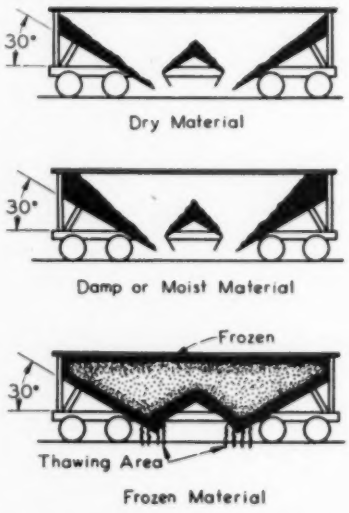
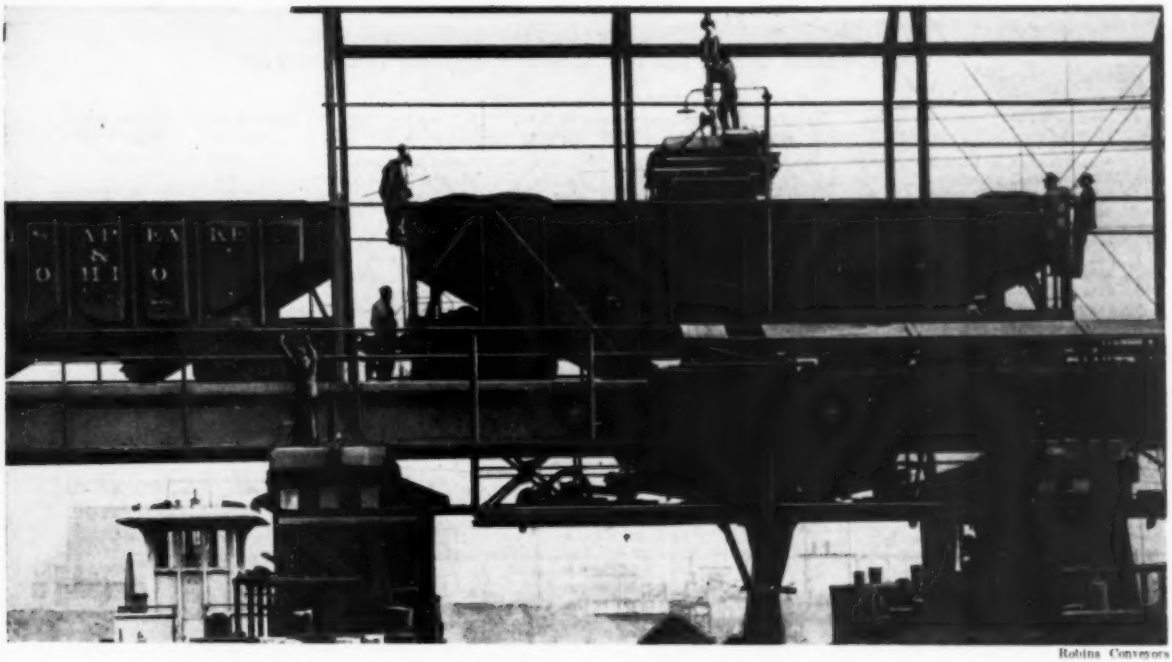


Fig. 1—Per cent volume of material remaining in hopper car after gravity.

Table 1 lists a series of products that may be transported in hopper cars along with their angle of slide. This is the angle to which the steel support plate must be tilted from the horizontal so the material will slide by the force of gravity. Also listed is the specific weight for each product. All of the data listed are considered to be under ideal conditions unless otherwise noted. "Under ideal conditions" means that the material is sized, there is little or no moisture, and no packing. This must be kept in mind when



Figs. 2, 3, 4—Material remaining in car after gravity under varying conditions.



Robins Conveyors

Testing a new car shaker in Charleston, West Virginia, that will unload the aveage coal car in about two minutes.

using this information because there are many variables, which could change the data presented.

Fig. 1 shows graphically the per cent of volume of material that remains in a hopper car after the force of gravity has removed its share of the load for various angles of slide. A typical 50 ton car, which has a volumetric capacity of 2100 cu ft when loaded full to the eaves was chosen. Based on the dimensions of the car and the angle of slide over 30 deg, the volume of material remaining in the car was computed and then divided by the volumetric capacity of 2100 cu ft. This resulted in a percentage of full load remaining in the car. Of particular interest is the fact that as the angle of slide increases one deg, the percentage of load remaining in the car increases very close to two per cent.

Adverse Conditions

When conditions vary from the ideal, the angle of slide increases. This in turn increases the volumetric percentage of full load that will remain in the car after gravity has done its work. This is significant in view of the fact that many of the materials listed in Table 1 as having a slide angle of 30 deg or less under ideal conditions, will have a slide angle of 30 deg or more when the ideal conditions are modified. Packing in transit, moisture, and partial freezing are a few of the conditions that will increase the angle of slide. For example, when absolutely dry, bituminous coal will slide at an angle of 29 deg, but when damp the angle of slide increases to 40 deg. In winter a hard enough freeze will prevent any material from sliding, and this necessitates thawing before the material can be removed through the hopper.

Mechanical Shaker

Figs. 2, 3, and 4 represent material in a hopper car under several conditions. The shaded area in the car represents the amount of material remaining after gravity has done its work. This is the amount to be removed by either manual or mechanical means. Unloading personnel have to rap the sides or actually climb into the car to dig and chop the material loose. This method, of course, can become dangerous and involves considerable time. A mechanical method, such as a car shaker, involves the use of only one man at the controls—away from all danger—and offers a considerable savings in the total man-hours required to empty a car of material.

Data in Fig. 1 do not give a complete picture of the involvement in unloading the material from a hopper car that gravity does not remove. Obviously, unloading oats is easier than moving an equal volume of cement. Therefore, the values obtained from the graph in Fig. 1 were expanded on a weight basis. The calculations involved three variables: (1) specific weight (lb per cu ft), (2) slide angle, and (3) percentage load remaining in the car. A summary is given in Table 2 on page 91.

Here is a brief explanation of how the calculations were made and by using the same method any of the materials given in Table 1 can be put through this process. The same hopper car was employed and it has a volumetric capacity of 2100 cu ft. A product was then selected from Table 1, and its specific weight was noted. The selection was blast furnace cinders which weigh 57 lb per cu ft. Multiplying 2100 cu ft by 57 lb per cu ft gives 119,700 lb, which is the total load in the car when full and level with the top. Referring to Fig. 1, this material has a slide angle of 35 deg (Table 1), and 10 per cent will remain in the hopper car. Multiplying 119,700 lb by 10 per cent will give the weight of material remaining in the car after gravity has removed its share. The amount in this case is 11,970 lb. Thus, under ideal slide conditions, almost 6 tons of blast furnace cinders would have to be removed by either human or mechanical means after gravity flow.

When considering a problem such as presented here, another factor must be considered before drawing any conclusions. That factor is the weight limit of the hopper car. For instance, a car may have a volumetric capacity of 2100 cu ft with a nominal load limit of 100,000 lb and a maximum load

TABLE I — ANGLE OF SLIDE AND SPECIFIC WEIGHTS OF VARIOUS BULK MATERIALS

Material	Angle of slide, degrees	Specific weight lb per cu ft
Alumina, sized or briquette	22	65
Alumina, fine, granulated	35	55
Aluminum, hydrate, ground	34	13.5
Aluminum sulfate, granular	32	54
Ammonium sulfate, damp, granulated	45	40
Ash, black, ground	27	105
Ash, volcanic, powdered	45	45
Ashes of bituminous coal	40	35-45
Ashes, damp	50	40-50
Babassu nuts, ground	40	45
Bagasse, wet sawdust	45	4
Barytes, granular	30	144
Bauxite, calcined (granulated without dust)	26	70
Bauxite, ground, dried	35	68
Bauxite, mine run	31	85
Bentonite, pulverized	42	50
Bones, animal, pulverized	50	58
Bone char, ground	35	40
Calcium bichromate, granular	25	62
Calcium carbide, spent, powdered	45	139
Calcium oxide, powdered	43	27
Carbon, ground	21	50
Carbon, coke, crushed, sized	28	30
Chalk, precipitated, powdered	45	18
Charcoal, bone, (carbonated granular)	27	60
Charcoal, wood pulp, granular	35	26.4
Chips, wood	22	15-30
Cinders, (coal, ashes & clinkers)	35	40-45
Cinders, blast furnace	35	57
Clay, dry in lumps, loose	35	40-100
Clay, blended for tile, 11 per cent moist, powdered	45	45
Clay, fire, powdered	45	25-80
Clay, pulverized, fire brick	35	100
Coal, anthracite, broken, of any size, loose	22	52-57
Coal, anthracite, chestnut	22	46
Coal, bituminous, minus ¼ in. slack dry	29	40-50
Coke, pulverized	34	25
Coke, petroleum, crushed	27	33-36
Copper oxide, powdered	40	190
Copper sulfate, ground	31	75
Cork, ¾ to 0 in.	30	6
Cryolite ½ in. to 200 mesh, crushed	32	52
Cullet (scrap glass sized)	25	80-120
Dolomite, pulverized	41	46
Dust, flue, blast furnace	45	40
Dust, limestone	38	55-65
Earth, fuller, raw	35	42
Feldspar (crushed)	32	100
Glass batch, average mix	45	100
Bran	36	16-26
Corn, field (on cob)	20	45
Malt, spent, dry	28	18
Gravel	30	120
Green stone trap, quarried in loose piles	35	107
Gypsum	45	142

Courtesy Stephens-Adamson Mfg. Co., Aurora, Illinois

limit of 129,100 lb. This means that on the basis of the nominal load limit (100,000 lb) any material weighing more than 47.6 lb per cu ft should not be loaded full and level with the top of the car. On the basis of the maximum load limit (129,100 lb) any material weighing more than 61.5 lb per cu ft should not be loaded full but proper load should be calculated.

This fact has a very interesting effect on the results obtained for some of the materials. For example, if the car could not be loaded full and level, there would be a smaller total volume of material in the car. Therefore, less material would flow out by gravity, and by the same token there might be less material remaining in the car, depending upon the angle of slide and the slide conditions. However, because of the higher specific weight of the material there might be a higher total weight of material remaining in the car than there would be for a lighter product that could completely fill the hopper car.

In order to easily analyze what happens when the slide angle or specific weight varies, refer to Table 2. The same range of specific weights was used with varying slide angles, therefore, the effect that varying either the slide angle or specific weight has on the total weight of material remaining in the car can be quickly determined from Table 2.

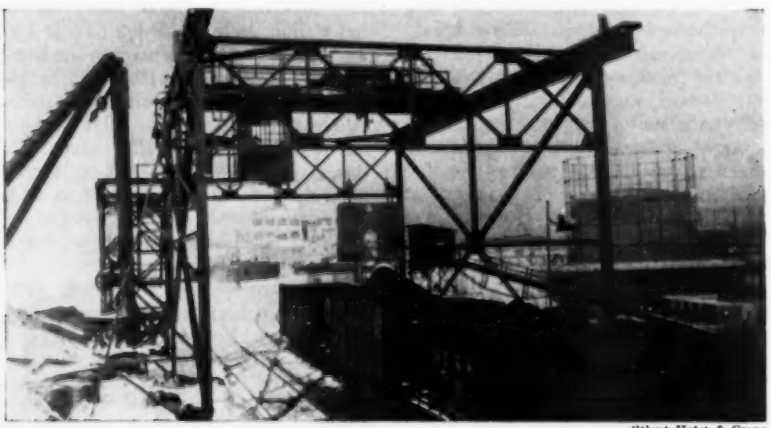
A car shaker, when set on the eaves of the car, will cause the bottom sheets to vibrate through a small amplitude. This vibration causes the material to feed down along the sheets to the openings. Proper centrifugal force and shaker speed will decrease unloading time without damage to the car or track supporting structure.

Practical Illustration

To show what actually can be accomplished with a car shaker, it is best to review a situation that existed at a large manufacturing plant. One of the earliest car shaker models was utilized to unload coal for use in the powerhouse. The flow of the coal is typical of many installations.

Coal drops from the car into a hopper which has a capacity of approximately 10 tons. From the hopper it feeds into a crusher and then is discharged into a bucket elevator, which loads a conveyor to supply the bunkers.

Before the car shaker was installed, three men were permanently assigned to empty the hopper cars, and during the winter months two additional men were required. Thus, three to five men, depending upon the conditions, were continuously working to keep enough coal flowing out of the hopper cars so that a sufficient amount was available



Silent Hoist & Crane

Another example of a mechanical car shaker used to unload frozen coal.

TABLE 1 — ANGLE OF SLIDE AND SPECIFIC WEIGHTS OF VARIOUS BULK MATERIALS

Material	Angle of slide, degrees	Specific weight lb per cu ft	Material	Angle of slide, degrees	Specific weight lb per cu ft
Gypsum in irregular lumps	30	82	Slag, furnace, granulated	25	122
Gypsum, ground	40	56	Slag, Birmingham	25	82
Ilmenite, granulated	31	148	Slate, fine ground	35	82
Ilmenite, fine ground	40	120	Slate, granules, flaky	28	87
Iron oxide pigment	48	25	Soapstone, fine ground	40	60
Kalsomine (powder)	42	32	Soda ash, light	37	25-35
Lead silicate, granulated	40	230	Soda ash, dense	32	66
Lead sulfate, basic pulverized	43	184	Soda ash, briquette	22	50
Lime, briquette	26	60	Sodium antimonate, crushed	31	49
Lime, burned, pebble (sized)	30	53	Sodium nitrate, granular	24	68
Lime, fine (spent, dry carbide)	40	45	Sodium sulfite, powdered	40	96
Limestone, pulverized	42	85	Sodium sulfate, (fine & lumps)	31	88
Limestone, mixed sizes	35	105	Stucco (tubed & untubed) powdered	36-38	50
Limestone, coarse, sized	25	98	Sulfur, coarse	32	76
Magnesium sulfate, (Epsom salts) crystals	25	55	Talc, micaceous granulated	36	62
Mica, ground	34	13.5	Tin oxide, ground	35	100
Molybdenite, ore, powdered	40	107	Tripoli (powdered)	40	80
Nitrate of soda, pellet type, granular	24	68	Beets, shredded sugar	31	7.6
Phosphate, florida, 20 mesh, air cleaned	27	93	Copra, medium sized pieces	20	33
Pumice, pulverized	45	40	Copra, expeller cake, chopped	20	29
Rock, phosphate, pulverized	48	60	Walnut shells, ground, 320 mesh	55	21
Rubber, scrap (ground)	35	23	Sawdust, dry	36	10-30
Salt rock, crushed, sized	25	75	Sawdust, ground	45	20
Sand, mine run	35	90-120	Wool, mineral	30	10
Sand, coarse, sized	30	90-100	Zinc calcides, powdered	54	85
Sand, very fine	32	90-110	Zinc oxide	45	20
Sand, core	39	65	Zinc oxide, leaded, ground	50	20
Sand, voids full of water	45	110-130	Zinc ore, roasted, granular	38	110
Silica, flour	45	80	Zinc sulfate, powdered	44	72

at the bunkers. The time required to empty a 50 ton car averaged about 1¼ hr, with variations from that figure depending upon conditions. Using the average time, in summer it required 3¾ man-hours, and in the winter it required 6¼ man-hours. Unloading by this method often required men to climb into the car to pound, dig, and chop on the material. Needless to say, the accident rate on this job was the highest of all the power plant activities.

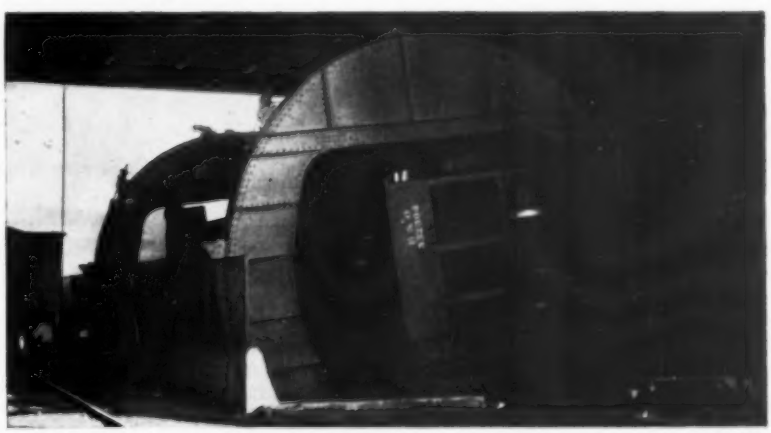
Since the car shaker was installed, only one man has been permanently assigned to empty the hopper cars. During severe cold weather when freezing of the material takes place, a second man is assigned to handle the thawing operation.

A car shaker will unload up to 15 cars of coal per hour depending upon the capacity of the material handling system and switching facilities. In one installation, a series of cars are emptied, without moving the cars, by moving the car shaker with a monorail hoist from car to car. Each car contains different analyses and is spotted over the correct receiving hopper.

Principle of the car shaker is simple. It must produce a relative movement between the slope sheet of the car and the material. Too low a car shaker speed will not produce the necessary movement, and too high a speed will damage the hopper car. By operating the car shaker only long enough to cause the material to flow out of the car, additional savings can be made.

TABLE 2 — REMAINING WEIGHT IN CAR AFTER GRAVITY FLOW

Slide angle, deg	Volume remaining in car from Fig. 1, per cent	Specific weight, lb per cu ft	Weight remaining in car, pounds
33	6	5	630
33	6	20	2520
33	6	30	3780
33	6	50	6300
33	6	60	7560
40	15	5	1757
40	15	20	6300
40	15	30	9450
40	15	50	15,750
40	15	60	18,900
50	40	5	4200
50	40	20	16,800
50	40	30	23,200
50	40	50	42,000
50	40	60	50,400



Link-Belt

This shows a different method of unloading by inverting entire car.

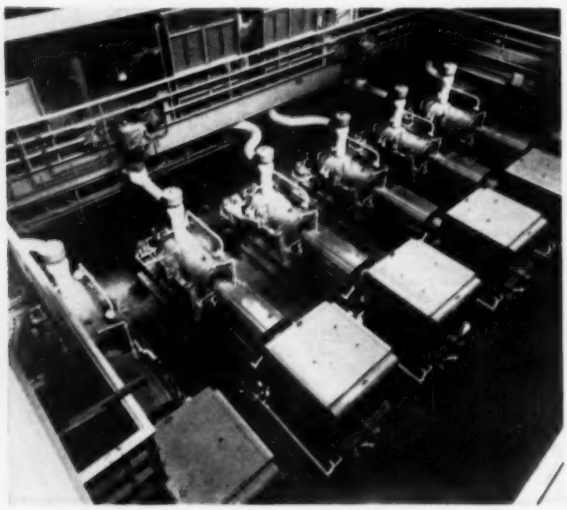


Fig. 1—Battery of six boiler feed pumps are operated with 2000 hp, 3600 rpm motors through fluid drives.

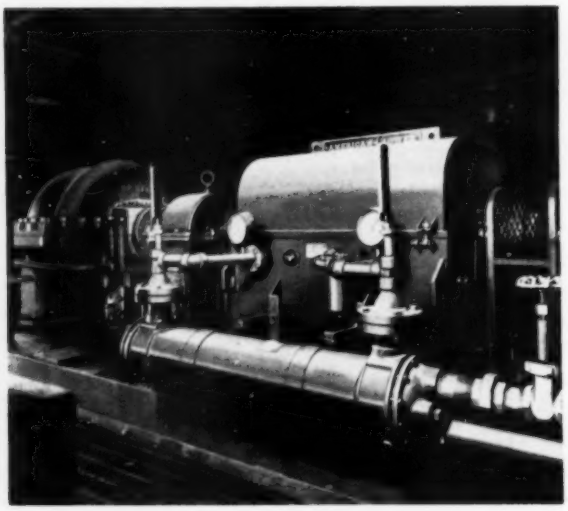


Fig. 2—Variable speed is obtained for this refrigeration compressor with a fluid drive and 400 hp motor.

Adjustable Speed Fluid Drives -- 2

Their Applications and Function

Interesting facts about the applications and functions of fluid drives. Part 2 concludes this series, offered to acquaint the engineer with the theory and application of this type of drive.

R. C. HABICHT

American Blower Corporation

ADJUSTABLE SPEED fluid drives have been employed for over twenty years in the power plant field in connection with both forced and induced draft fans. They also were installed with low speed motors and step-up gears for boiler feed pump drives. This type of installation has proven its value to such an extent that a demand arose in the power plant field for an adjustable speed fluid drive for boiler feed pump application at 3600 rpm.

Such a unit was designed and first introduced in 1946. Since that time hundreds of boiler feed pumps have been installed and are operating with this type of unit. The drive is designed to operate at 3600 rpm and has been built in sizes to handle up to 12,000 hp.

Fig. 4 shows the pump characteristic curves for an actual installation in the Mid-West. Pressure and horsepower are shown for both constant and variable speed operation. It was specified that each pump be capable of delivering up to and including 460,000 lb of water per hr. Normal operating range was between 175,000 and 400,000 lb per hr. A comparison of constant and variable speed curves of horsepower and pressure quickly points out the basic advantages of variable speed operation of the boiler feed pumps.

Feed pumps must be selected to develop the required boiler outlet pressure plus friction losses in superheater, boiler, economizer, feedwater valve, piping, and high pressure heaters, with a margin for blowdown. The pump selected for this maximum condition has excess capacity throughout normal operating range. Constant speed operation requires that the pump discharge

be throttled, and that as much as 500 to 600 lb be wasted through the feedwater regulator valve.

Slow Speed Operation

The fluid drive permits the pump to operate at lower speeds when less feed water flow is required, and reduces losses in the regulator valve, resulting in a corresponding saving in horsepower. For example, referring to Fig. 4, at 200,000 lb per hr the fluid drive input is approximately 100 hp less than for the constant speed drive and the variable speed pressure is 500 psi less than the constant speed pressure.

The variable speed pump horsepower curve in Fig. 4 is based on a constant suction pressure. In most cases the boiler feed pump suction pressure is not constant but is related to the discharge pressure of the condensate pump. When the boiler feed pump operates at reduced speed with reduced flow, the discharge pressure of the condensate pump increases. The boiler feed pump only has to produce the difference between the condensate pump discharge pressure and the required boiler pressure, plus friction. When the condensate pump pressure increases at reduced flows, the boiler feed pump has to produce less pressure, resulting in greater horsepower savings than are indicated in Fig. 4.

In addition to the horsepower savings, which can be evaluated in terms of dollars and cents, the reduced wear and maintenance on the pump and the improved control characteristics are important points to be taken into consideration.

Bearing and gear wear in any piece of machinery is directly related to operating speed. Fluid drives permit the pumps to operate at the minimum possible speed consistent with the flow requirements.

Hunting Eliminated

When fluid drives are installed, the controlling mechanism is not in, or affected by, the water flow stream. Therefore, the drive control is less subject to sticking and hunting. Fig. 3 is an actual flow chart taken from the installation represented by the curves in Fig. 4. This chart shows a wide range of water flow over the 24 hr period with very good control. The design rating for this job was 460,000 lb per hr, but the maximum flow shown is about 380,000 lb per hr. In fact the chart only goes to 450,000 lb per hr. This indicates a horsepower savings over the entire normal range of operation, and this has been found to be typical in most installations studied.

Fig. 2 shows an installation of a variable speed drive for a centrifugal refrigeration compressor. Centrifugal fans, pumps, and compressors are similar in operation. Although there are differences in operating conditions, power savings can also be demonstrated on fans and centrifugal compressors.

Advantages

In addition to the power savings and reduced maintenance, applying the drive to centrifugal refrigeration compressors has other distinct advantages. Because of the nature of the application, the automatic controls on a refrigeration job may call for frequent stopping and starting of the motor. Slow speed operation or declutching without stopping the motor is permissible. With higher horsepower motors and direct drives, it is not always possible to include automatic starters, but with fluid drives the motors can be started under no load conditions. After the motor is up to speed, the load can be applied gradually by engaging the scoop tube.

Motor Type

It is common practice to use synchronous motors with centrifugal refrigeration machines, and here the fluid drive offers simplified starting. Also, during periods when no refrigeration is required, the motors float on the line to provide power factor correction with the minimum of horsepower consumption.

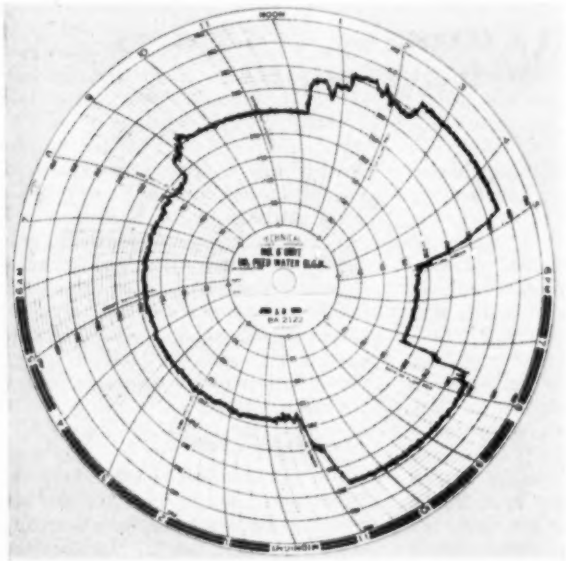


Fig. 3—Flow chart shows load characteristics of a fluid drive installation. Note lack of hunting.

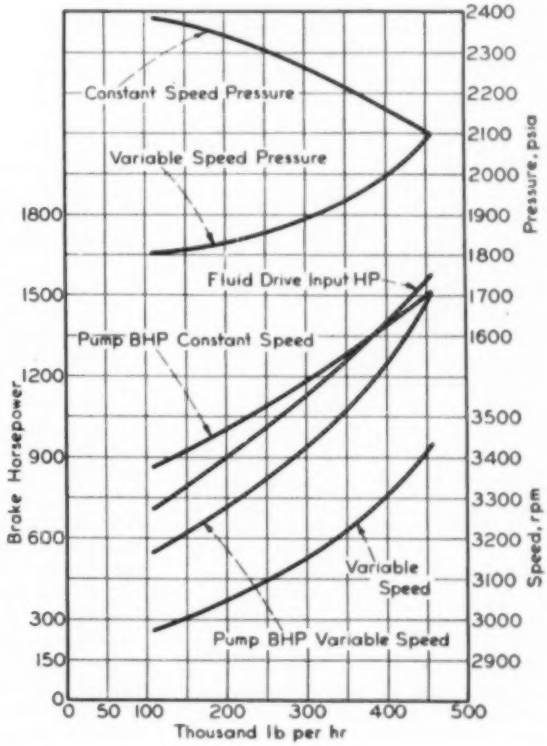


Fig. 4—Typical characteristic curve of a fluid drive shows difference between constant and variable speed.

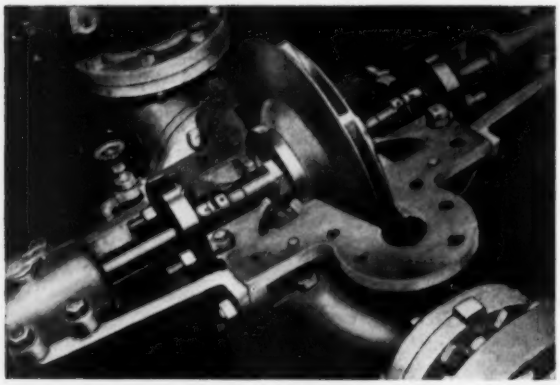


Fig. 1—This single mechanical seal is installed in the lower half of a horizontally split casing pump.

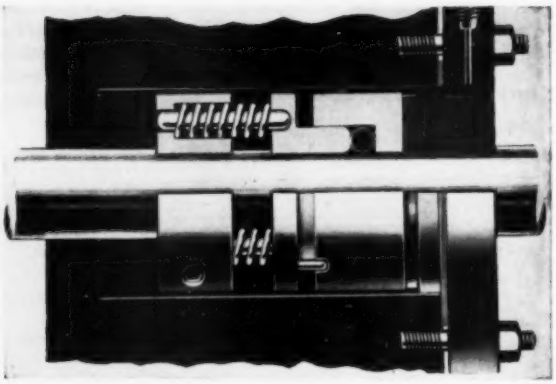


Fig. 2—Details of the mechanized seal illustrated at left. Photograph shows the two points of contact.

Centrifugal Pumps . . .

Mechanical Stuffing Box Seals

Mechanical stuffing box seals play an important part in keeping fluids within the pump and keeping air out. Here are the mechanics of such seals.

IGOR J. KARASSIK and ROY CARTER
Worthington Corporation

THERE ARE many conditions of service met in the field where the conventional stuffing box design and composition packing are impractical as methods for sealing a rotating shaft. In the ordinary stuffing box, the sealing between the moving shaft or shaft sleeve and the stationary portion of the box is accomplished with rings of packing forced between the two surfaces and held tightly in place by a stuffing box gland. Leakage around the shaft is controlled by merely tightening or loosening the gland studs.

Actual sealing surfaces, which move relatively to each other, are the axial surfaces of the shaft or shaft sleeve and the packing. When an attempt is made to reduce or eliminate all leakage through a conventional stuffing box, the gland pressure is increased. Packing, being semi-plastic in nature, forms more closely to the shaft and tends to cut down leakage. Beyond a certain point, however, regardless of how tightly gland studs are brought up, the leakage continues. Frictional horsepower increases rapidly at this point, heat generated cannot be properly dissipated, and the stuffing box fails to function.

These undesirable characteristics eliminate the use of packing as the sealing medium between rotating surfaces if the leakage is to be held to the absolute minimum under severe pressure conditions. This, in turn, automatically eliminates the axial surfaces as a sealing surface, since a semi-plastic packing is the only material, which can be made to always form about the shaft to compensate for wear. With these facts in mind, mechanical seal designers have had to attempt an entirely different type of seal using wearing surfaces other than axial surfaces of the shaft and packing.

Objective of a mechanical seal is to afford a positive, leakproof seal for a wide range of fluids such as corrosive acids and gritty, contaminated, or inflammable liquids, and to develop in so doing the minimum of frictional resistance and consequent power loss. All mechanical seals, while they differ in various physical respects, are fundamentally the same in principle. In each one sealing surfaces are located in a plane perpendicular to the shaft and usually consist of two polished surfaces running adjacently, one surface being connected to the shaft and the other to the stationary portion of the pump.

Complete sealing is accomplished at the fixed members. Polished or lapped surfaces are of dissimilar materials and are held in continual contact by a special spring arrangement. They form a fluid tight seal between rotating and stationary members with small frictional losses.

Leakage past a good mechanical seal is negligible and could be considered as non-existent. Of course, some wear occurs, and provision must be made for a very small amount of leakage. Operation of a seal can best be understood by reference to a few standard commercial units.

Mechanical Seal

Fig. 1 illustrates a typical application of a single mechanical seal installed in the lower half of a horizontally split casing pump. Construction of this seal illustrated in Fig. 2. The gland with the gland insert is fitted into the casing and is the stationary member of the seal assembly. A seal is provided at two points: first, by means of the gaskets between it and the stuffing box face; and second, through contact with the seal ring face. The

This article will be included in a book on centrifugal pumps now being prepared by the authors; hence, all rights to republication are reserved by them.

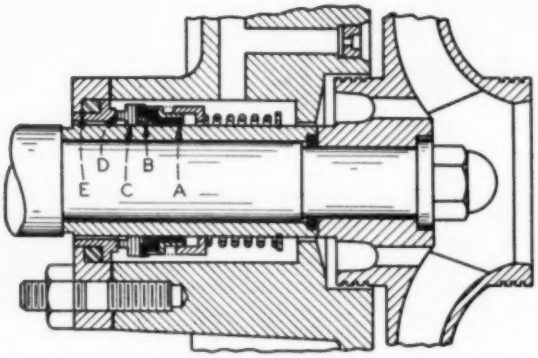


Fig. 3—Spring loaded synthetic rubber bellows type mechanical seal has extremely good sealing qualities.

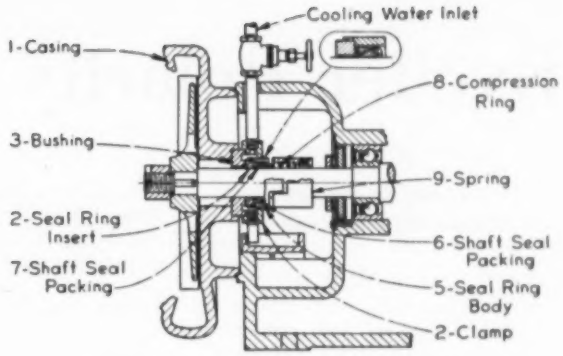


Fig. 4—When outside fluids cannot be employed for a seal, this mechanical device can be used instead.

mating seal ring with a hardened steel surface rotates with the shaft and is held against the stationary member by a compression ring. The latter supports a nest of springs, which are connected at the opposite end to the collar, which in turn is fixed to the shaft. The seal ring is fitted with packing, which prevents all leakage between the seal ring and shaft. One face of the seal must be flexibly mounted so as to keep the surfaces in full contact, regardless of any shaft deflection, this being accomplished by springs and an ample clearance between the shaft and seal ring proper. At the same time, the collar keeps all other rotating members of the seal in position.

Gland inserts, which are in contact with the seal ring, are made of anti-frictional material. They can be designed for lubrication.

Two mechanical seals may be mounted inside a stuffing box to make a double seal assembly. Such an arrangement is frequently used for sealing centrifugal pumps handling abrasive, extremely corrosive, or dangerous liquids, or liquids at very high temperatures. This double seal is also employed when the pump handles a gritty liquid. A cooling liquid is supplied between the two seals at a pressure higher than exists at the interior of the pump adjacent to the first seal.

Fig. 3 illustrates a spring loaded synthetic rubber bellows type mechanical seal. The tail of the synthetic rubber bellows A seals on the shaft; the head is flexible and adjusts automatically for washer wear and shaft end play. Protective ferrule B prevents the flexing area of the bellows from sticking to the shaft. Sealing washer C has a positive drive through metal parts and seals against the stationary floating seat E. The two sealing faces D are lapped at the factory and provide a seal against all leakage.

The mechanical seal illustrated in Fig. 4 has proved extremely satisfactory in chemical service under the following conditions:

1. Where an independent water seal on a packaged stuffing box cannot be used because:
   a. Incompatibility of traces of water with liquid pumped—such as with sensitive reaction products including crystallization, separation, and vinegar generation, also battery acid (dilution during shutdown), and remote control pumping.
   b. Water not available.
   c. Process limitations, such as heat of dilution with concentrated sulfuric acid (70-98 per cent) and anhydrous products, acetic anhydride, and acid-solvent mixtures.
   d. Inadequate or inexpert attention with possible costly hazard or maintenance.
2. Where fluid or grease seals on a packed stuffing box cannot be effectively installed.
3. Where it is impractical to operate pump with regulated (negative) pressure at stuffing box.
4. When liquid to be pumped attacks all known packing.
5. Where there is possibility of abrasive solids impregnating packing, such as slurry pumping.

This seal is made up of the following elements:

1. *The stator member* is a simple ring or bushing (item 3) fitting into a loose recess in the pump casing (item 1). It is bolted to the casing, with stainless alloy bolts, against a corrosion resisting gasket (same material as between pump casing and suction head). Therefore, it can be easily removed for relapping or replacement. This bushing is grooved to prevent recessing of rotor face into a worm surface.
2. *The clamp* (item 2) for bolting the bushing to the casing is hollow to provide a channel for cooling water. (The mating faces of a seal last longer if kept cool).
3. *The seal ring body* (item 5) is made of stainless alloy with a replaceable insert (item 4) for the wearing face. Materials used for the insert are corrosion resistant and have physical properties designed to resist wear when rotating against the bushing at high speed. (Over 4000 hr have been recorded with one set of mating faces in a sulfuric acid-nitric acid mixture).
4. The shaft seal (items 6 and 7) is made permanent by using inert Teflon plastic rings. These are made to take up against the shaft and seal ring body with an adjustable spring.
5. *The backup ring and spring* (items 8 and 9) are made of stainless alloy. The single coil spring is sturdy and should outlast the pump. The backup ring or drive collar engages the seal ring body by tongue and groove design with ample overlap. Flexibility is provided without interfering with accuracy. The spring is housed so it cannot loosen or become disengaged. Stainless alloy slotted set screws lock the backup ring at the proper place on the shaft to provide correct spring pressure and hold seal faces together under varying pump suction pressures.

Fig. 5—Exploded view of typical mechanical stuffing box parts.

Preventing

Exciter Polarity Reversals

FRANK E. REEVES
Consulting Engineer

ACCIDENTAL REVERSALS of the polarities of shaft-driven exciters are very annoying, and frequently costly. Such reversals have been known to occur on exciters associated with turbine-driven or diesel-driven generators rated up to 2000 kw under fault or other conditions.

The basic cause for such reversals is the operation of the exciter on the steep part of its magnetization curve. Under such conditions, a small change in exciter field flux will cause a wide change in exciter voltage. A shunt-wound exciter may be considered somewhat unstable when so operating; it is vulnerable to small disturbances which would have little effect if the exciter were operating on the knee or above the knee of the magnetization curve.

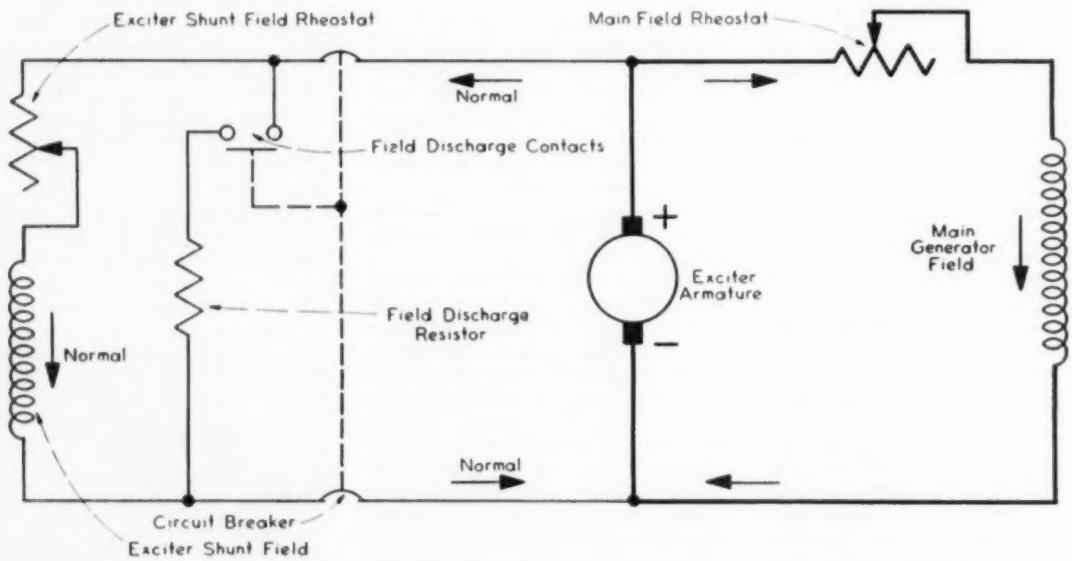
The normal direction of current flow is shown below in a typical excitation system for a small synchronous generator. The current flowing as designated "Normal" might reverse and cause complete reversal of the exciter under fault conditions in the circuits being fed by the main generator. Similar effects could be produced by a sudden decrease in resistance in the main generator field rheostat, or by a sudden increase in resistance in the exciter shunt field rheostat. Such sudden changes might be effected manually, or by voltage regulators. In any case, the result would be to cause the voltage across the exciter's armature terminals to drop suddenly.

When the exciter armature voltage drops suddenly, the energy stored in the main generator field will tend to discharge back into the exciter circuit. Since the inductance in the exciter's shunt field is relatively small, its time constant is smaller, and current from the main field may overcome and reverse the direction of flow of current in the shunt field of the exciter. If enough magnetomotive force is produced in the reverse direction under these conditions, the flux of the exciter field may be reversed. This will cause the exciter to build up voltage in the reverse direction when the disturbance is over. If the cause of the trouble is not immediately analyzed correctly, and if the main generator is disconnected from the system, a further extension of the original disturbance may result.

There are many possible ways to prevent such reversals. Several methods follow and some judgement must be exercized as to which should be employed. There is no inexpensive cure-all, and it might be advisable to try the least costly remedies first, if such experimentation is practicable.

Obviously, the most effective preventives would be ones which insure that the exciter operates above the knee of the magnetization curve at all times, regardless of generator loading conditions. There are several methods of accomplishing this; other methods for preventing reversals are also given. Although they are much less costly, they do not provide as much positive assurance of success as do those which maintain exciter operation above the knee of the magnetization curve.

A method for preventing exciter reversals is to add resistance in the main generator field circuit which makes the exciter more stable by placing operation of its shunt field at higher magnetic densities at all times. If there is a

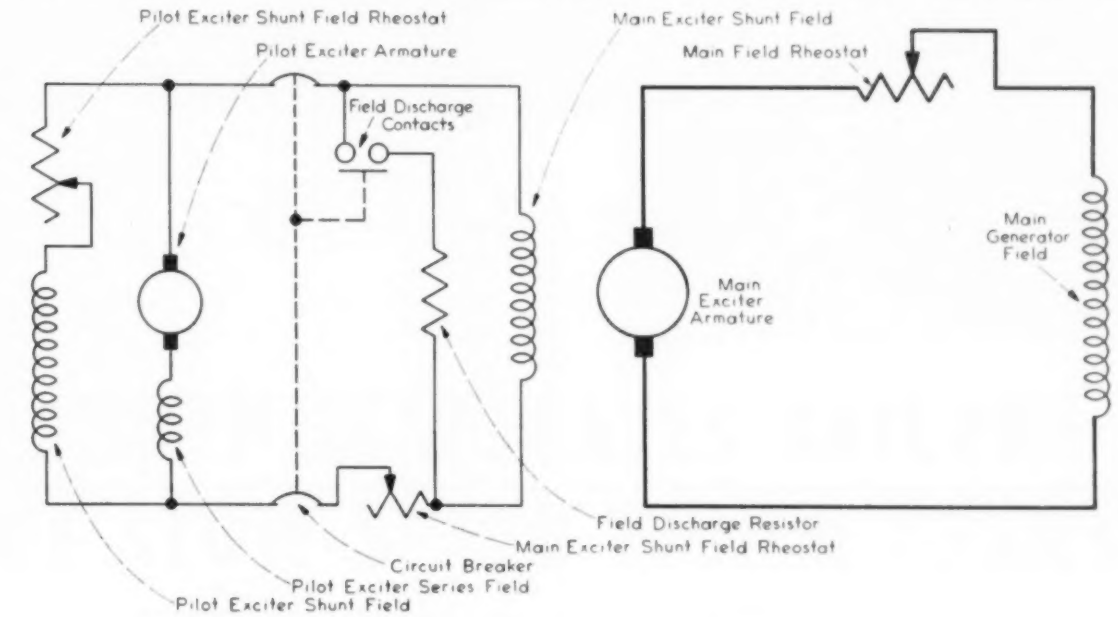


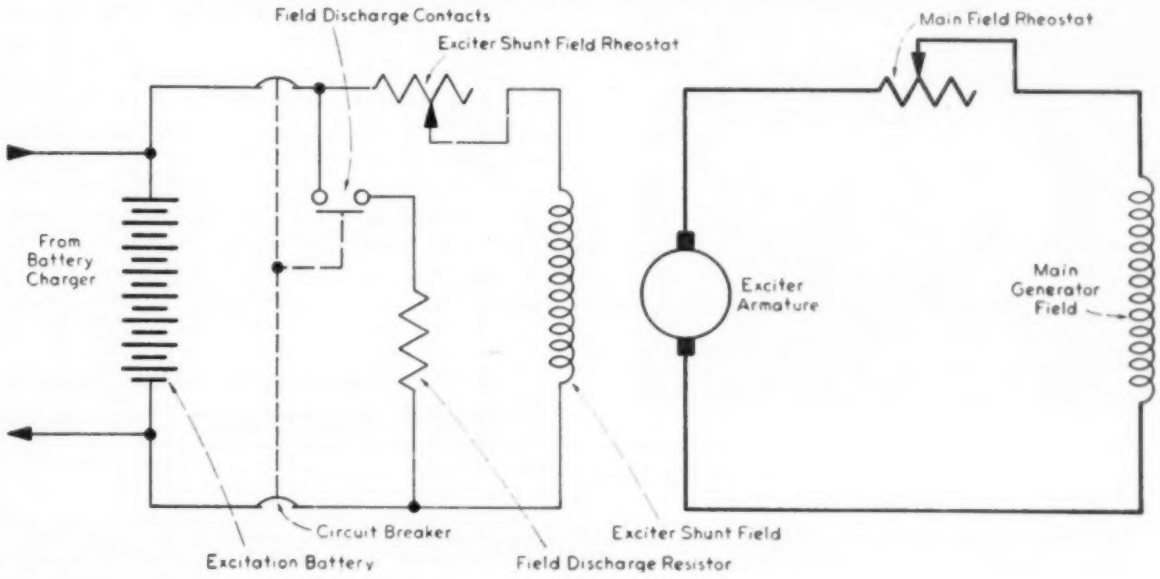
Normal current flow in an exciter field circuit. Under conditions causing exciter polarity reversal, the exciter field current (represented by the "Normal" arrows) would reverse, tending to reverse the exciter armature magnetic field.

main generator field rheostat, it should be run to its maximum resistance position and not changed. All regulation of main generator field current is then accomplished by varying the exciter's shunt field rheostat. If there is no main generator field rheostat, or if its resistance is insufficient to produce the desired results, a fixed resistor of the proper value may be added to the circuit. Limitations of this scheme may include the constant extra energy loss in the added series resistance, inadequate regulation by means of the exciter shunt field rheostat, or lack of suitable space for installing the extra resistor. Care should be taken that with the added resistance, the exciter is operating on the steep part of the magnetization curve, under all conditions of leading, voltage, and power factor.

Another basic approach is to isolate the exciter field from the exciter armature. A separate excitation battery can be used as a source for the exciter shunt field circuit. Since this field thus is isolated, the main generator field cannot discharge into it, and stability would be maintained. A pilot exciter would insure against reversals in the same manner as the battery, but entails more expense and difficulty in first cost, installation, and wiring; however, battery maintenance is eliminated. Although not shown, a Wheatstone-bridge-type shunt field rheostat is sometimes used with a pilot exciter insuring operation on the high part

Isolation of the exciter field from the exciter is often effective. A pilot exciter can be used to energize the main exciter (top). Another approach is to supply exciter field energy from storage battery having its own charging supply (below).

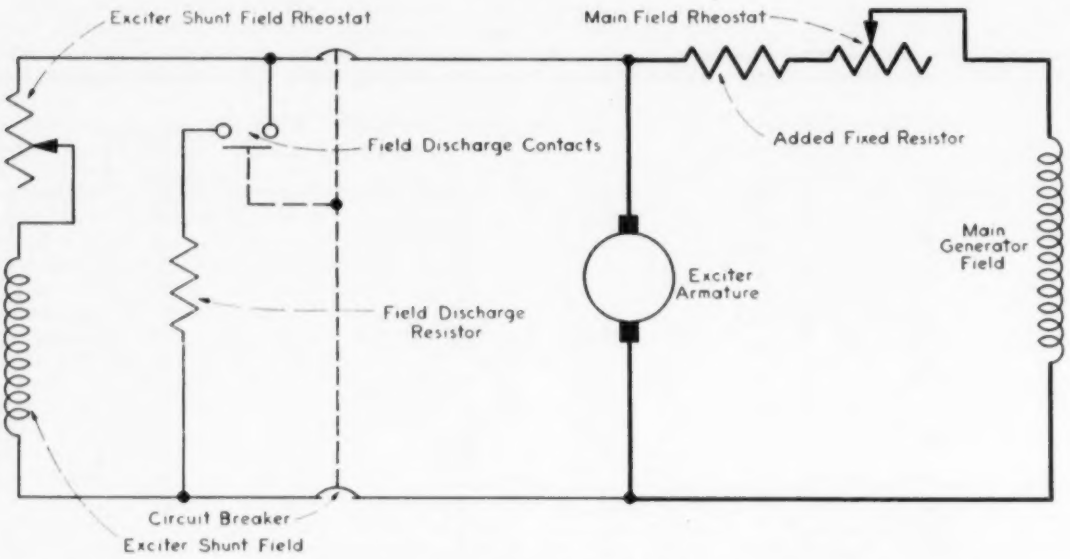




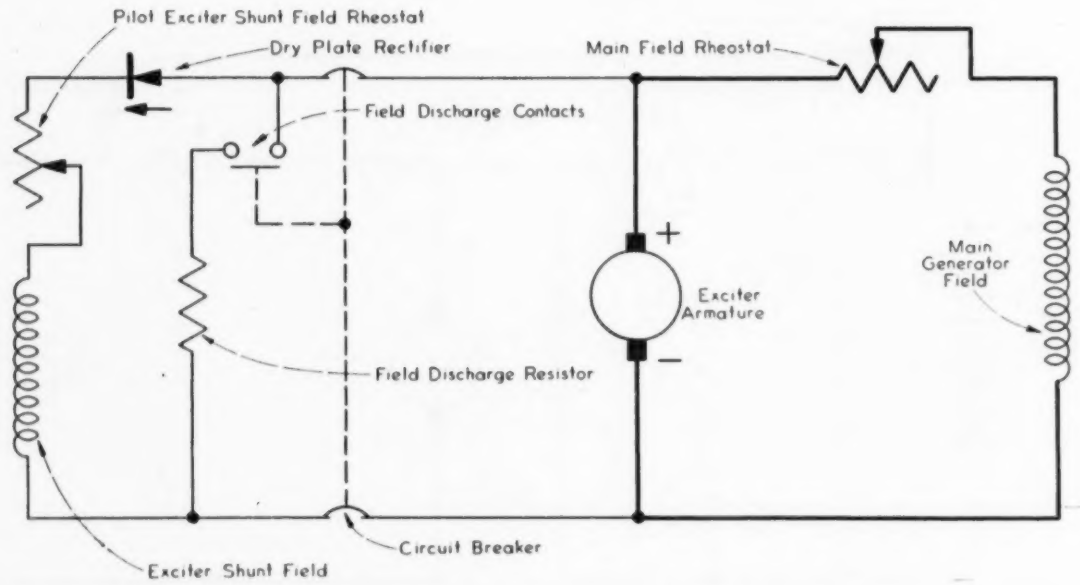
of the magnetization curve whenever in operation.

A very inexpensive modification and one which should be effective in a majority of cases is addition of a selenium rectifier. With proper current and voltage characteristics, it is connected to permit current flow in the proper direction and prevent its reversal. Since the exciter shunt field current is relatively small, the current carrying requirements would be light. The back voltage, when current tended to reverse, could not be much higher than the normal exciter armature voltage. A reasonable factor of safety could be allowed without increasing the cost of the rectifier above a very moderate value, especially since a half-wave unit would be entirely adequate.

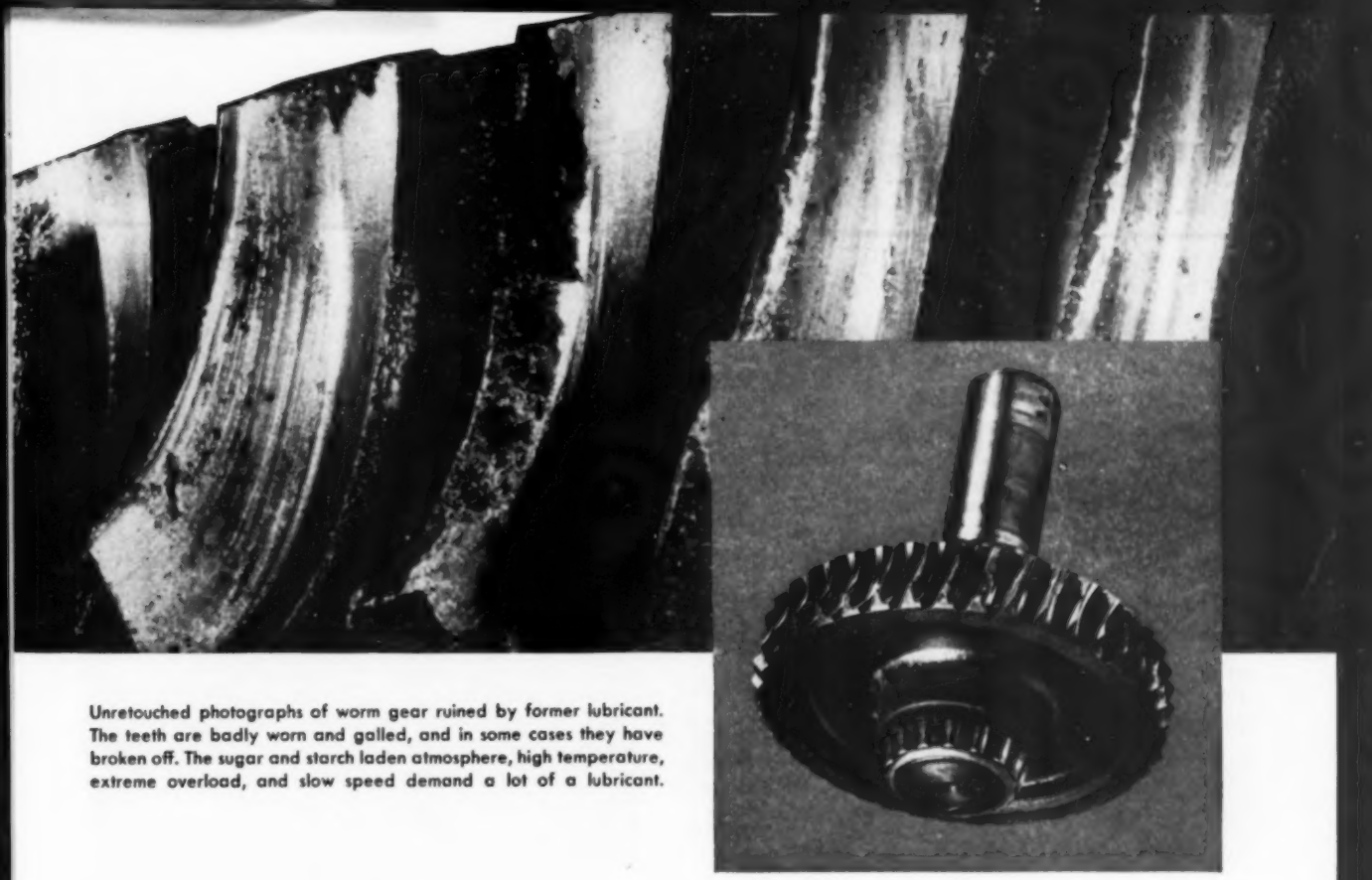
The least expensive method, but perhaps the one offering the least chance of being effective is the shifting of the exciter brushes a few degrees forward. The result would be a flattening of the exciter's volt-ampere characteristic, resulting in less voltage drop as the current in the armature increased under transient conditions. However, there would be some sacrifice in regulation, and sparking at the commutator might become excessive.



A simple expedient for maintaining operation of the exciter beyond the knee of its magnetization curve is the addition of resistance to the main generator field circuit; this is practical if space permits and if energy losses are tolerable.



Exciter field current reverses are stopped by the high reverse impedance of a dry-plate rectifier in the exciter field circuit. Normal exciter field current meets the negligible forward impedance of the rectifier with only small losses.



Unretouched photographs of worm gear ruined by former lubricant. The teeth are badly worn and galled, and in some cases they have broken off. The sugar and starch laden atmosphere, high temperature, extreme overload, and slow speed demand a lot of a lubricant.

SUNEP ELIMINATES FAILURE OF SLOW-SPEED WORM GEARS

To help satisfy America's sweet tooth, Leaf Brands, Inc. resorted to a 70% overload on its revolving candy pans. This weight, plus slow speed, sugar and starch-laden atmosphere, and surrounding high temperatures, resulted in an average of 450 worm gear unit failures in one year. The lubricant could not take it.

After a test of a number of extreme pressure lubricants Sunep was selected. Because of damage caused by the former product, some units broke down during the first months following the change-over. But in the last 5½ months there hasn't been a single failure. Far less Sunep has been required, and records show an overall saving of over $20,000 in the year it has been in use.

Send for our new booklet "Sunep"—it will not obligate you. SUN OIL COMPANY, Philadelphia 3, Pa., Dept. IP-6

These revolving candy pans operate at 30 rpm. Sunep keeps them turning in spite of 70 percent overload.

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY SUNOCO®

PHILADELPHIA 3, PA. • SUN OIL COMPANY LTD., TORONTO & MONTREAL

Lubricating Oils and Greases for Gears and Bearings • Refrigeration Oils • Motor Oils • Way Lubricants • Hydraulic Oils • Pressure System Greases • Cutting Oils • Rubber and Textile Process Aids • Waxes • Petrochemicals

spot news

. . . what's happening in U. S. industrial plants

Westinghouse Leaves Stoker Manufacturing Business

Westinghouse Electric Corp. is leaving the industrial stoker manufacturing field. Arrangements have been made for renewal parts and stoker service to be supplied by Detroit Stoker Co. of Monroe, Mich. In making the announcement, J. K. Hodnette, vice-president of Westinghouse, stated that the agreement does not include the sale of plant facilities at Attica, N. Y.

The company will continue to operate the stoker manufacturing plant and foundry until all contracts for complete stokers, currently on the books, are fulfilled. Completion of contracts is expected within three to four months. Beyond that, Mr. Hodnette stated that future plans for the Attica plant have not been definitely formulated.

"Westinghouse is relinquishing its stoker manufacturing business only after long and serious consideration," he said. "We feel that it is not now closely enough related to our other activities to justify our continued participation."

Coach Displaying Automation Practices Will Tour Country

Automation, one of the most talked about subjects today, has been put on wheels by the Westinghouse Electric Corp. Developed by the Standard Control Div., it is being taken directly to engineers in the machinery manufacturing industry throughout the United States. The display is intended to demonstrate how electrical devices, such as linestarters, control stations, motors, and circuit breakers, can be used to achieve successful automation.

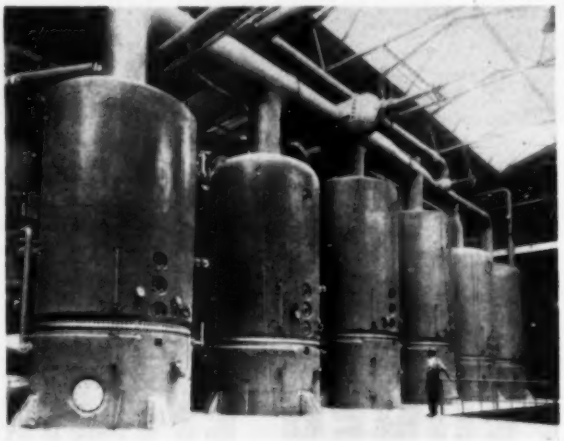
To make it as easy as possible to attend a showing, the coach is taken to the customer's plant and runs consecutive 1½ hr programs for groups of ten to twelve engineers at a time. Highlighting the introductory portion are movies on "Automation Economics" and "Automation Mechanics."

Second portion of the meeting consists of informal presentations, many of which are animated to simulate actual factory conditions. Displays are arranged so that the engineer gets a progressive picture of present automation practices. The coach, which will start its country-wide tour in the mid-western sector, is expected to make some 350 plant visits over a period of 14 months.

The Cover — Piqua Power Plant

This month's cover illustration shows (left to right) Charles J. Lahman, Consulting Engineer; John P. Gallagher, Director of Municipal Utilities; and Walter I. Barrows, Consulting Engineer, discussing a feature at the Piqua Ohio Municipal Power Plant.

The item under discussion is the Selsyn motor mounted at the side of the turbine which drives the induced draft fan. This Selsyn unit positions the bypass needle valve on the turbine oil pressure control system and permits remote adjustment of turbine and fan speed from the boiler control panel. Similar drives serve the other plant auxiliaries.



Swiss Firm Grants Manufacturing Rights To American Company

Broad sales and manufacturing rights for the North American continent have been granted the Cleaver-Brooks Co., by Escher Wyss Co. of Zurich, Switzerland. The latter company is among the world's oldest and largest designers and manufacturers of Kaplan, Francis, and Pelton type hydraulic turbines, pumps, steam and gas turbines, centrifugal and axial flow compressors, heat exchange apparatus, and evaporation equipment. It operates plants at Zurich, Switzerland; Ravensburg, Germany; Schio, Italy; and Boksburg, South Africa.

Among the factors reported to have contributed to granting the rights to Cleaver-Brooks is the part taken by this company in the development of the compression evaporator. This evaporator, sometimes termed a "heat pump" machine, is finding widespread application in the fields of evaporation and concentration. One of the largest such units in the world is shown in the illustration. Heart of the compression evaporator is the compressor. It was Cleaver-Brooks' worldwide search for the most advanced compressor designs, and the finding of such designs at Escher Wyss, that first brought the two concerns together.

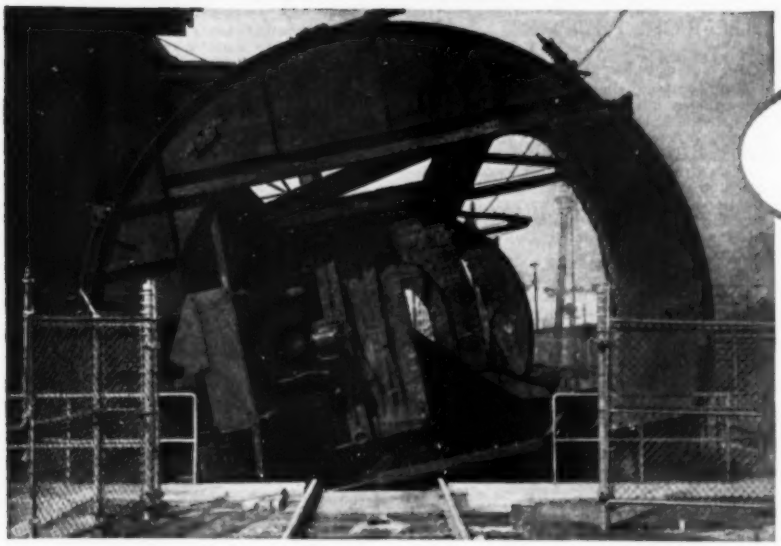
Another contributing factor was the American firm's research in the concentration and disposal of spent sulfite liquor in paper mills. Concentrated liquor has a high fuel value, and has been widely used in certain European countries due to the relative scarcity and higher cost of other fuels. A major aspect in concentrating waste liquors

(Continued on page 124)

Why Link-Belt builds both...

Car Shakers

EASIER ON CARS with minimum noise level . . . thanks to exclusive low-frequency vibration. The Link-Belt Car Shaker helps hopper cars empty themselves. Even hard-packed loads come "broom clean" in a matter of minutes. Especially good for damp, sticky materials. Write for Book 2345.



Rotary Dumpers

BOTTOMS UP . . . empties 90 ton car every 60 seconds or less by simply turning car upside down (including return to upright position)! That's how fast Link-Belt Rotary Car Dumper unloads gondolas. Simple, automatic, foolproof. Takes all open-type cars—any length, width or height . . . up to 90-ton or 120-ton capacity. Book 2048-A has complete data.

Read how you can empty railroad cars fast, gently—at lower cost

YOU'LL get push-button car-unloading with either the Link-Belt automatic Rotary Dumper or the low-frequency Car Shaker. Both of these Link-Belt products can whisk gondola cars "broom-clean" in a remarkably short time.

We build the Rotary Dumper for large users . . . the Car Shaker for smaller operations. That's why you can be sure you get the right railroad car unloader for your particular requirements. Each of these precision-engineered products reduces operational hazards, minimizes injury possibilities, cuts costly demurrage charges.

If you empty a few gondola cars a day—or several thousand a week, call the Link-Belt district office nearest you. Get all the facts on how you can cut your railroad car unloading costs.

LINK-BELT

CAR SHAKERS and ROTARY DUMPERS

LINK-BELT COMPANY: Plants: Chicago, Indianapolis, Philadelphia, Colmar, Pa., Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia). Sales Offices in Principal Cities. 13,202

new bulletins

. . . catalogs from leading manufacturers

AIR FILTERS & DUST COLLECTORS

200—Electonic Air Cleaners

Electronic air cleaners, designed to completely clean ventilating air, are the subject of 4-page folder AF-106. An installation for cleaning air in a power house control room located in a steel mill is described. Trion, Inc.

201—Cloth Screen Collector

Advantages of a self-cleaning cloth screen dust collector are tabulated in 16-page folder 915. How the unit maintains constant collector performance and efficiency is discussed. Design details, construction, and specifications are included. Pangborn Corp.

202—Desk Calculator

Useful formulas, constants, and conversion factors for basic engineering of blast cleaning and dust control calculations are contained in a 6-page pocket size folder entitled "Desk Calculator." Included are geometric relationships for circles, squares, cylinders, spheres, pyramids, cones, and trapezoids; measures of pressure; and calculation guides for determining tank capacities in gallons. Other major categories include formulas for dust control work, tables on shot and grit sizes, and metric measurements and conversion factors. Pangborn Corp.

203—Dust Collection

"The Collection and Recovery of Industrial Dusts," 32-page booklet 101, explains how industrial dust recovery boosts plant yield, improves product and process, and eliminates air pollution. It discusses various types of dust and techniques used in analysis, and lists the factors which influence choice of equipment. Operation of cyclone collectors, electric precipitators, and low draft loss collectors is explained. Hopper valves and units for special purposes also are presented. Buell Engineering Co., Inc.

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ELECTRICAL EQUIPMENT

204—Voltage Regulation

Why voltage should be regulated, and advantages of using packaged equipment to provide this regulation, is explained in 8-page bulletin GEA-5928. Units combining the transformer, regulator, and breakers all in one package are discussed. Applications, basic construction, and specifications are outlined for various a-c lighting and power service units up to 112.5 kva at 600 v. General Electric Co.

205—Distribution Transformers

Brief descriptions of distribution transformers from 25 to 1000 kva, with various primary and secondary voltages, are presented in 4-page folder 50-FC. Units are air-cooled. Standard lighting transformers also are listed. Marcus Transformer Co., Inc.

206—Plug-in Panelboards

Features of plug-in distribution panelboards, for 250 and 575 v operation, are appraised in an 8-page bulletin. Engineering data and application information, together with specifications, are presented. Federal Electric Products Co.

207—Rectifiers

Application of rectifiers to various operations is explained in a brochure. A question-and-answer section explains the benefits of keeping d-c equipment working on a-c while retaining d-c speed control. Construction features and advantages are summarized. American Rectifier Corp.

208—Wire & Cable

"Wires & Cables for the Chemical and Petroleum Industries," a 76-page booklet, has been published to serve as a reference book on this subject. It is divided into four main sections: insulation compounds; jacket compounds; constructions; and technical data. The compound sections have been expanded to include butyl insulation, heat and moisture-resistant insulations, thermoplastic types, general-purpose neoprene jacket, and polyvinyl chloride type jacket. Electric Wire and Cable Dept., United States Rubber Co.

209—Reference Book

"Motor and Generator Reference Book," 50-page booklet 51R7933, presents information to assist in the selection of motive power to handle most industrial applications. Considerable data and information of value are presented and supplemented with illustrations. The booklet is reprinted from the 1952 edition of "Lincoln's Industrial-Commercial Electrical Reference." Allis-Chalmers Manufacturing Co.

210—Motor Starters

How to select the correct starter for squirrel-cage induction motors rated up to 600 v, is the subject of 4-page selection guide 14B7733. Information tells how to select the proper type starter, enclosure and operating arrangement, and explains how to determine whether a full or reduced voltage starter should be used. An explanation of two or three-wire control and hints on selection of heater elements for overload relays also are given. Allis-Chalmers Manufacturing Co.

211—Dripproof Induction Motors

Dripproof induction motors, from 1/3 to 150 hp, are described in 6-page brochure RS-2. In addition to standard motors, special purpose types such as vertical, flange and face mounting, magnetic brake-types, and shell-type units are discussed. Speed torque curves, frame number charts, dimensions, and specifications are presented. Recent changes in design are discussed, including use of prelubricated, sealed ball bearings throughout. The Lima Electric Motor Co.

212—Feeder Voltage Regulator

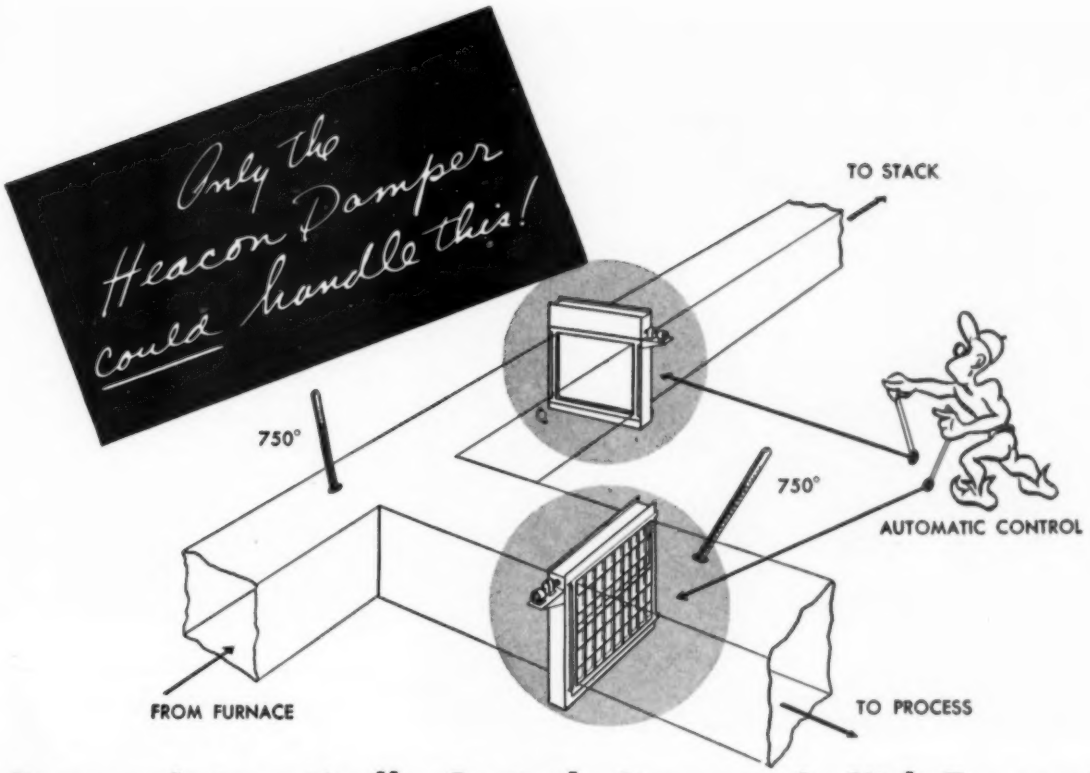
How to install, operate, and maintain feeder voltage regulators is the subject of 28-page "Users Manual" O1X7002B. The manual includes connection and installation diagrams, tables for calculating setting of line drop compensator, gives maintenance hints, and describes such specialties as the Vari-Amp feature, forced air cooling, and oil-sealed inert gas protection. Allis-Chalmers Manufacturing Co.

213—Non-Metallic Power Cables

Construction features and advantages of zero to 5000 v non-metallic, sheathed power cables, for direct burial installations, are discussed in 12-page bulletin OK-1066. Current carrying capacities and specifications are tabulated. A section entitled, "How to Install Buried Cable," contains useful information for extending cable life and preventing service interruptions caused by mechanical damage. The Okonite Co.

(Continued on page 104)

NOTE — Each new bulletin item has a key number for your convenience in asking for a free, personal copy. Insert key numbers on return post card found on page 115.



Damper *Automatically* Controls Dangerously High Temperatures

. . . Safeguards Expensive Processing From Contamination

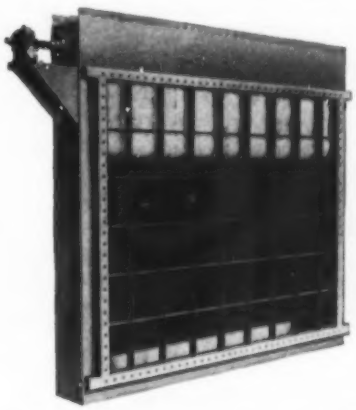
In this installation the safety and success of a new process depends on two factors:
1. Automatic control of high temperatures.
2. Assurance of safety when temperatures approach danger zone.

The process would be impossible without instantaneous and tight shut-off of heat to process and without automatic and dependable venting of heat to the stack. Damper leakage here could mean the loss of thousands of dollars in processing time and materials—not to mention the possible destruction of the plant and its personnel!

Temperatures and pressures had to be under quick, fool-proof control. That's why Heacon Dampers were specified. *Heacon is the only damper made that can assure the positive tightness and control so necessary in this installation!*

The Heacon Damper is a radical departure from conventional damper design. There are no louvers to leak . . . no possibility of warpage. The greater the pressure the more tightly it seals!

Heacon Dampers are designed and constructed to meet practically any pressure or temperature specifications. Our engineers will be glad to discuss your problems with you.

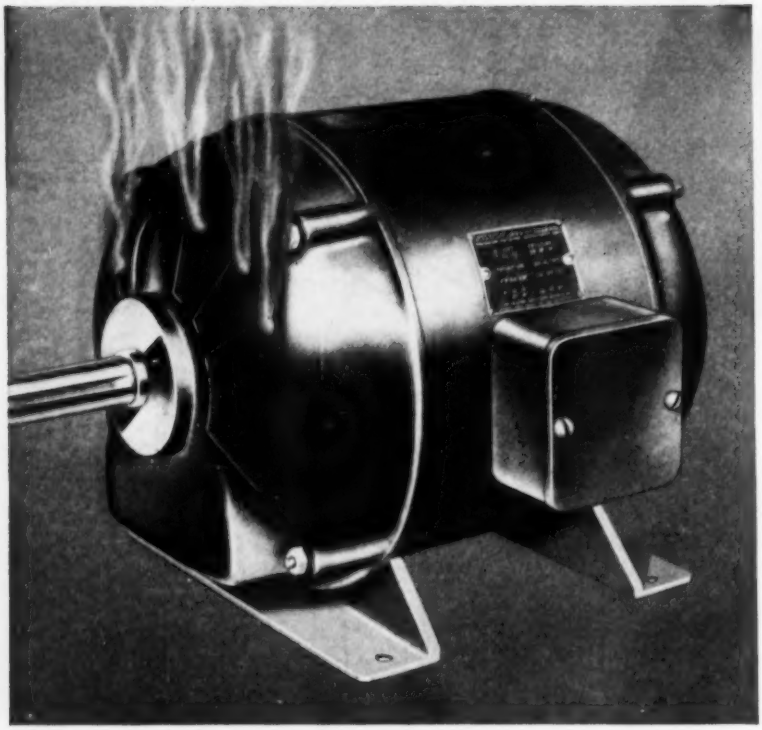


Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD., 1440 St. Catherine St., W., Montreal 25; Quebec, 983 Bay St.; Toronto 5, Ontario, Canada



You can avoid motor burnouts

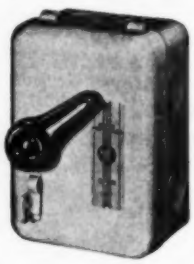
THE temperature surrounding motor protection equipment is an important factor in motor burnouts. In order to prevent nuisance stoppages in hot weather, the rating of protective equipment is often raised. Then, when plant temperature drops, protection is inadequate . . . motors are more subject to burnout.

This explains why an ever-increasing number of plants are standardizing on HEINEMANN Circuit Breakers as manual motor controllers. Set tripping points of HEINEMANN Circuit Breakers *are completely independent of ambient temperature.*

Moreover, HEINEMANN Circuit Breakers provide inverse time delay to permit starting inrush or harmless, temporary overloads . . . yet they provide the fastest circuit interruption available on large overloads, stalled rotors, single-phasing or short circuits.

HEINEMANN Circuit Breakers operate on a hydraulic-magnetic principle. They do not employ thermal elements or heaters. They are available with precise ratings to the motor, and are provided with time delay characteristics especially suited to trouble-free motor protection.

don't use heat
...USE POWER



Send for Bulletin 1410.

HEINEMANN ELECTRIC CO.

140 PLUM STREET • TRENTON 2, NEW JERSEY

new bulletins

(Continued from page 102)

BOILERS & BOILER ACCESSORIES

214—Boiler Baffles

"More Steam from Your Boilers," a 4-page folder, explains how streamlined baffles are applied to all types and sizes of the company's boilers. Drawings indicate how they are installed in each specific unit to secure crossflow of gases. The literature also points out how gas passes are tapered in area to obtain necessary velocity for maximum heat transfer. The Engineer Co.

215—Package Boilers

Package boilers for gas, oil, or combination oil and gas firing, are appraised in 10-page bulletin A-104. A large cutaway view shows design and construction features of the Scotch-type boilers. Units from 20 to 100 hp are listed. Dimensions and specifications are tabulated. Eclipse Fuel Engineering Co.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

216—Steam Accumulators

Balancing steam supply and demand with steam accumulators is the subject of 8-page bulletin RA-52-8. Typical installations are discussed. Principles of operation and advantages are described, and data are presented for calculating capacity. Practical application of accumulator theory is discussed. Foster Wheeler Corp.

217—Gage Valves

Liquid level gage valves for liquid and flat glass gages are described in a series of nine data sheets 187-195. Specifications are listed, and such details as operation and advantages are presented. Jerguson Gage & Valve Co.

218—Scotch Marine Boiler

Subject of 16-page bulletin 509 is an automatic, self-contained steam generating plant for firing oil, gas, or combination oil and gas. Construction of the boiler and firing equipment is described. Specifications are listed for units up to 250 psi for power, process, or heating; and units for 15 psi steam or 30 psi water for low pressure heating. Standard and extra equipment is discussed, and installation and maintenance suggestions are presented. Johnston Brothers, Inc.

219—Off-Center Firing

Design features of a compact, automatic package boiler are discussed in 4-page folder EC-1152. The theory of off-center firing, used with these units, is discussed. Specifications for units through 250 hp are tabulated. Dutton Boilers Div., Hapman-Dutton Co.

220—Over-Fire Air Systems

"Smoke is Wasted Fuel," a 4-page folder, describes how over-fire air systems

(Continued on page 106)

Guaranteed TO SHUT TIGHT*

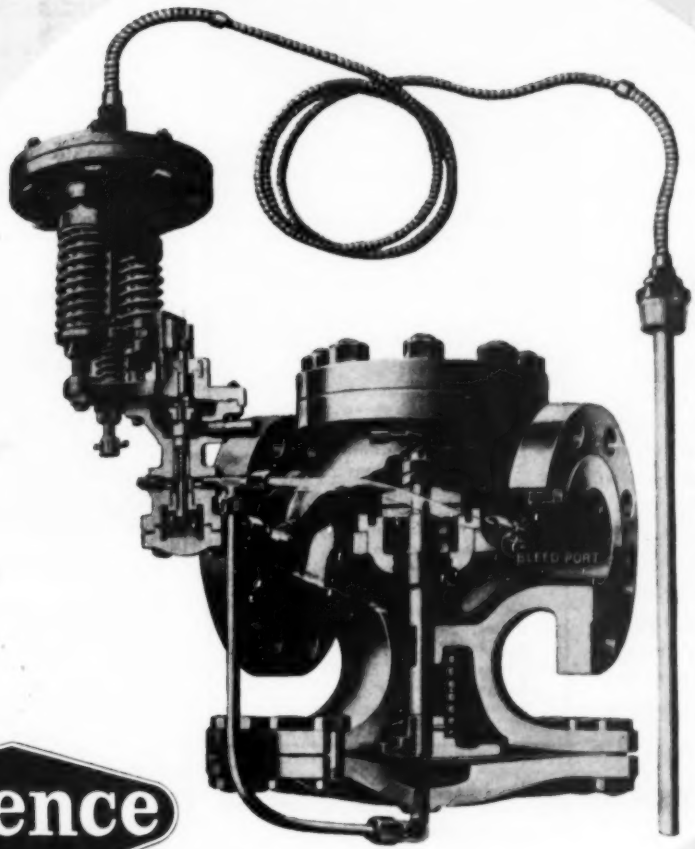
*When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.



SPENCE
TYPE ET150
Temperature
Regulator

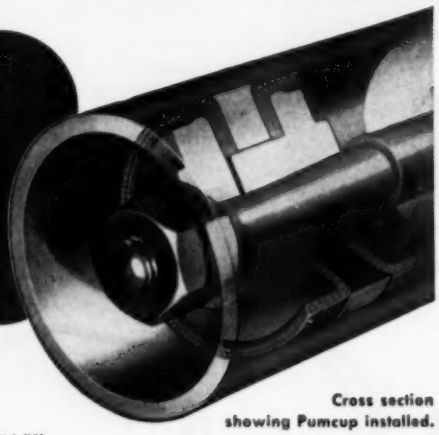
Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

(SE 130)

PRESSURE UP! COSTS DOWN!

Slippage Reduced
in PUMPS
AIR CYLINDERS and
HYDRAULIC CYLINDERS
with
DARCOVA PUMCUPS



Cross section showing Pumcup installed.

NORMAL wear of ordinary packing reduces efficiency to a tremendous degree.

In contrast, Darcova Pumcups actually retain their efficiency . . . and they outlast most other packings at least 3 to 1!

Their scientific construction makes it possible to reach *and hold* peak efficiency. Under pressure Pumcups hug the cylinder walls to provide a uniform seal and exert full pressure where it is needed. This means reduced slippage, lower power costs and far less maintenance.

Write for helpful data-and-proof bulletins: No. 4502 on Pumcups for air and hydraulic mechanisms; No. 4401 on Pumcups for reciprocating pumps.

Cost-minded engineers in many industries have standardized on Pumcups to solve their packing problems. The list of successful applications includes the following installations:

Die casting machines
Forming and drawing presses
Straightening presses
Pipe bending machines
Briquetting machines
Pusher mechanisms
Door control devices
Lifting and dumping devices
Spraying equipment
Proportioning pump regulators
Recoil cylinders
Air booster pumps
Grease guns
Automatic bottling and filling machines
Extrusion presses
Steering mechanisms

DARCOVA
THE ORIGINAL COMPOSITION CUP

DARLING VALVE & MANUFACTURING CO.
WILLIAMSPORT 9, PA.

PUMCUPS

new bulletins

(Continued from page 104)

operate. How an automatic control with electric eye can be applied to the systems is explained. Instructions on how to select the proper size are presented, together with a selection chart and a table of fan data and characteristics. Canton Stoker Corp.

221—Oil Burning Equipment

Oil burners, combination gas and oil burners, oil pumps, and accessories are described in 20-page booklet 3048. Subjects such as how to select a burner, engineering and manufacturing factors, construction features, principles of operation, typical installations, basic firing operation, automatic operation, and use of panel or control boards are presented. Engineers concerned with selection of firing equipment should find considerable information of value in this booklet. Petro Div.

HEATING, AIR CONDITIONING, & REFRIGERATION

222—Gas-Fired Unit Heater

Suspended space heaters for use with any type of gas fuel are the subject of 6-page folder 543. Complete specification data, with dimensions and capacities of both propeller fan and blower type units, are presented. Output capacities are listed from 70,000 to 178,000 Btu per hr. How they can be used in industrial applications for heating, ventilating, and process drying, either with or without ductwork, is explained. Heating Dept., Dravo Corp.

INSTRUMENTS & CONTROLS

223—Water Meter

Operating principles of a new single-register, compound water meter are explained in 10-page bulletin W-803. Features, advantages, construction, and connections are outlined. Capacities from 160 to 1000 gpm are listed in a table of specifications. Rockwell Manufacturing Co.

224—Pyrometers

Pyrometers for the indication and control of temperature and industrial processes, and for the protection of heat-processing equipment, are described in 12-page booklet GEC-713B. Design features, applications, operation, functional principles, construction, and specifications for various types of indicating and controlling pyrometers are presented. Information on thermocouple components, hand pyrometers, thermocouple potentiometers, resistance thermometers, and industrial resistance bulbs also is presented. General Electric Co.

225—Controllers

Millivoltmeter type instruments, including indicators, indicating electronic controllers, and excess temperature safety cut-off controllers, are described in 24-page catalog 1053. Information on operation and applications of on-off, two position, three-position, and pulse type time-proportioning controllers is included, as well as data on primary measuring elements and dimensions. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

226—Controllers

Free-vane air-operated controllers are described in 32-page booklet A120. Instruments for automatic control of pressure, temperature, liquid level, flow, humidity, pH, and electrical variables are described. Data are provided on on-off, proportional, reset, derivative, reset plus derivative, and autoset types of controllers. The Bristol Co.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

227—Recording Meter

Described in 20-page bulletin 401 is a mercury flow type indicating, recording, and totalizing meter for accurate measurement of water, gas, air, sewage, sludge and industrial liquors. Descriptions of the meter include facts on its operation, construction, general information, sizes and capacities, specifications, and other pertinent data of interest to plant engineers. Simplex Valve & Meter Co.

BUILDING MATERIALS & MAINTENANCE

228—Sump Cleaning

Sump cleaning with vacuum equipment is the subject of 4-page folder 130-C. According to the bulletin, this equipment can pick up liquids at the rate of 40 gpm, and has a tank capacity of 125 gal. Improved vacuum units for picking up water from floors and ducts also is described. The equipment may be connected to a vacuum cleaning system, or may be provided as a portable unit with capacities to 8 gal. The Spencer Turbine Co.

DIESELS & GAS ENGINES

229—Gas Diesel Engines

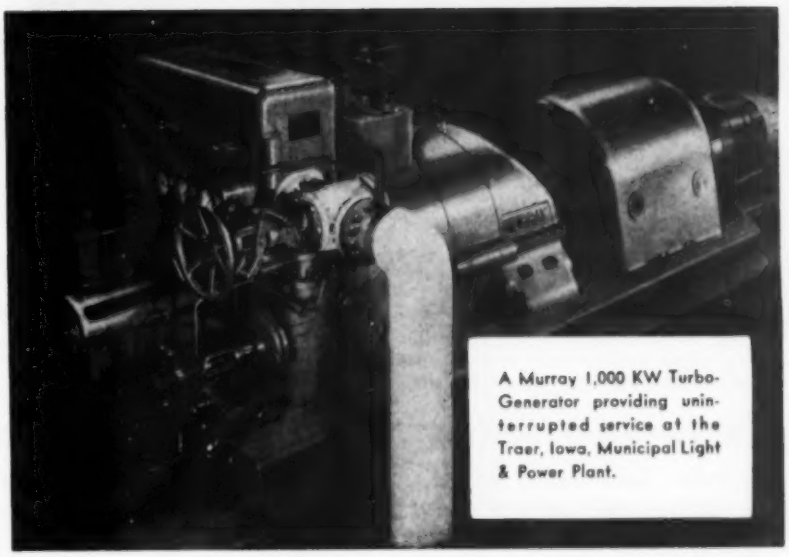
Engines for gas, gas-diesel, and diesel operation are described in 12-page bulletin L-71. Units are 4-cycle, with 15½ in. bore and 22 in. stroke. A rating curve compares supercharged to atmospheric operation. Aftercooling for more horsepower is discussed. Space requirements are listed, and typical installations are described. Cooper-Bessemer Corp.

230—Diesel Electric Sets

Five models of diesel electric sets, with ratings up to 110 kw, are described in 20-page bulletin 30507. A cutaway view shows features of design. The booklet describes fuel, lubrication, and cooling systems; points out advantages of several important parts; contains descriptions of both self-regulated generators and completely automatic standby sets; describes attachments; and gives complete specifications. Caterpillar Tractor Co.

(Continued on page 108)

Murray Turbines



A Murray 1,000 KW Turbo-Generator providing uninterrupted service at the Traer, Iowa, Municipal Light & Power Plant.

A typical, modern, small public utility is the Municipal Light and Power Plant at Traer, Iowa. This plant supplies water, steam heat and electric power to the community and surrounding countryside. The Murray turbo-generator pictured above carries the full electrical load of the plant and supplies the steam for heating by automatic extraction at 10# gauge pressure.

The simplified design and rugged construction of this and all MURRAY turbines particularly adapt them to this or any other drive where long life, reliability and low operating costs are a MUST.

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BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

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Boiler Blow-off Valves...

Teamed Up For "EVERLASTING" Service

The unique service qualities of EVERLASTING Blow-off Valves have long been demonstrated in boiler-rooms throughout the country. Now their superior design features have been teamed up in these EVERLASTING Duplex Blow-off Units.

HERE'S WHAT YOU GET WITH THESE DUPLEX UNITS

Valve shown on left of unit

- Lever- or wheel-operated types—as you desire
- Unrestricted flow — straight-through
- Rotating sliding disc—self-grinding, self-lapping
- Drop-tight seal—improving with use
- Non-wedge action — no sticking, no jamming

Valve shown on right of unit

- Straight-way or angle types to select from
- Strength to withstand repeated shock of blow-off force
- Exceptional resistance to erosion, abrasion and rust
- No pockets to permit lodgment of solids
- Positive action, self-cleaning

Not only do these EVERLASTING Duplex Blow-off Units provide an absolutely drop-tight seal — they are so constructed that long and repeated operation will not affect this tightness. Other Duplex Units for varied requirements are shown in our Bulletin.

Either valve of any EVERLASTING Duplex Unit can be supplied separately. But for boiler blow-off applications, any one of the complete EVERLASTING Duplex Units assures absolute safety — at low maintenance cost.

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for everlasting protection

new bulletins

(Continued from page 107)

231—Heavy Duty Engines

"New Developments in Oil Diesel, Dual Fuel Diesel and High Compression Spark Ignition Engines," 16-page booklet S-500-B55, describes up-to-date features of modern, economical, heavy duty, internal combustion engines. A heat balance chart shows waste heat recoverable from exhaust gases and jacket cooling water. Also included is bulletin S-500-B54, which contains fuel cost charts for determining most economical type of engine selection, and reprints describing industrial and municipal installations utilizing heat recovery systems. Engine Div., Worthington Corp.

LUBRICANTS & LUBRICATION EQUIPMENT

232—Oil Reclaimer

Subject of 4-page folder R-247 is a self-contained, compact oil reclaimer for keeping industrial oils free from contaminants. In addition to describing how the process works, the bulletin suggests a few of the more common applications. The Hilliard Corp.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

233—Filtration Equipment

How various industrial plants have used filtration equipment to solve specific problems is discussed in a series of 4-page case studies. Each study discusses the problem and its solution. The first folder appraises a central system for reconditioning cutting oil before it reaches automatic machines. A second study describes a central flotation system for clarification of soluble coolant. Industrial Filtration Div., U. S. Hoffman Machinery Corp.

MATERIALS OF CONSTRUCTION

234—Rubber Lined Construction

Advantages of rubber lining for steel tanks, drums, pipes, valves, fittings, and pumps for storing and handling acids and corrosive chemicals are appraised in an 8-page bulletin. Tables give resistance of rubber lining to inorganic acids, salts and alkalies, organic materials, and miscellaneous materials. Details on abrasive and temperature resistant qualities also are discussed, and the various types of linings are described. Protective Coatings Div., Metalweld, Inc.

235—Structural Plastic

Information on fabrication and design factors, physical strength, and chemical resistance of unplasticized, rigid polyvinyl chloride is provided in 6-page folder 9-1. Techniques of fabrication are discussed, with illustrations of fume exhaust systems, tanks, ducts, dipping baskets, and similar products. Resistance charac-

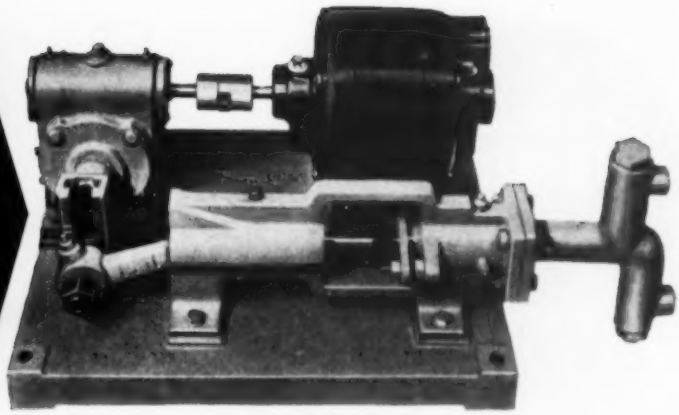
(Continued on page 110)

for water softening,
boiler treatment and
all chemical applications..
we introduce

ORCHEM

LITTLE GIANT PUMP

small . . . compact . . .
efficient . . . economical . . .



As its name implies, the *Orchem Little Giant Pump* is small and compact. But it's designed to do a *big* job, economically. It's ideal for water softening, boiler treatment and all chemical applications up to a P.S.I. of 800 lbs.

In addition to the *Little Giant*, Orchem makes many types and sizes of standard and special pumps for every conceivable purpose. Efficient and economical, the *Little Giant Pump's* advantages result from Orchem's many years of "know-how".

Every Orchem pump is thoroughly tested for volumetric efficiency, conformance to pressure requirements and general mechanical operation under actual operating loads.

Write for descriptive literature. Furnished in Simplex and Duplex design for capacities to 3000 G.P.H. and pressures up to 30,000 P.S.I.

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Suction and discharge sides consist of a radically new integral double ball and seat unit—two balls and two seats—in one complete unit. Direct flow in and out assures minimum slippage. Non-air binding. Maximum displacement efficiency. Inexpensive units easily removed with large standard screwdriver.

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All Metal THERMOMETERS

with WESTON dependability built-in

The heart of the modern, dial-type thermometer is the all-metal temperature element. Developed over 15 years ago, the WESTON all-metal element has plenty of proof behind it. In fact, the dependable accuracy of this unit has made the readable WESTON thermometer favorite for laboratory use as well as for all industrial temperature needs. For *extra* dependability, specify WESTON all-metal thermometers . . . available in the types, ranges and sizes indicated below. Literature available. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J.

Type	Scale Length	Ranges		Stem Length		% Accuracy of Therm. Range
		As low as	As high as	As short as	As long as	
Heavy Duty Straight Form	9"	−100F	+1000F	2½"	48"	1
Heavy Duty Angle Form	9 or 12"	−100F	+1000F	2½"	72"	1
Standard Angle Form	6"	−100F	+1000F	2½"	72"	1
General Purpose	4½"	−100F	+1000F	2½"	36"	1
Laboratory	3.46"	−100F	+500F	2"	24"	½ of 1

WESTON *Instruments*

799

new bulletins

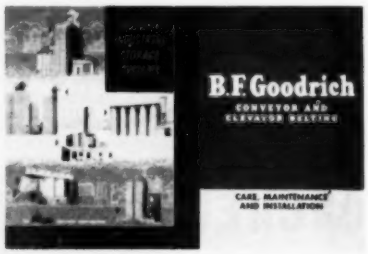
(Continued from page 108)

teristics are charted to clearly indicate applicability to specific industrial corrosion problems, as well as its resistance to reagents at both low and high temperatures. Atlas Mineral Products Co.

MATERIALS HANDLING EQUIPMENT

236—Storage Systems

"Modern Industrial Storage Systems," 12-page brochure 4393, discusses the subject of storage for raw ingredients, semi-processed, or finished material. The flexibility and adaptability of concrete silos is discussed. Descriptions of component parts and construction are supplemented with line drawings. The Marietta Concrete Corp.



237—Conveyor Belting

Installation and maintenance of conveyor and elevator belting is the subject of a 36-page engineering manual. An explanation of how to select belts includes considerable engineering data. Among the many topics covered are: systems for handling wet, corrosive, sticky or freezing material; how to make conveyor belts run straight; causes and effects of excessive tension; selection and installation of pulley lagging; ways to avoid belt wear at loading point; use of damage-preventing appliances; and the effects of defective idlers. The B. F. Goodrich Co.

238—Car Spotters & Pullers

Vertical capstan and horizontal drum type car spotters and pullers are appraised in 24-page booklet 2092. Features and specifications for many types are presented. Engineering information for calculating rope pull for railroad cars, and for planning layouts, is included. Although designed specifically for moving railroad cars, the brochure suggests many other industrial applications requiring horizontal haulage. Link-Belt Co.

PUMPS & COMPRESSORS

239—Controlled Volume Pumps

Described in 4-page folder H20M is a recently developed positive displacement pump designed for water treating and other industrial applications which do not require extreme accuracy. Applications, capacities, materials of construction, and motor-drivers are discussed in the bulletin. Milton Roy Co.

STEAM SPECIALTIES

240—Separators & Purifiers

Live steam separators, exhaust steam separators, air and gas separators, receiver type separators and steam purifiers,

and exhaust heads are described in 24-page catalog 500. Design features, proper trap, to use, and specifications are presented for each type. Engineering data includes charts giving pressure drop, steam capacity, and air capacity, as well as nomographs of steam flow in pipes and pressure drop in steam piping. Wright-Austin Co.

MECHANICAL POWER TRANSMISSION

241—Electric Clutch

Principles of operation of an electrically controlled clutch are explained in 16-page bulletin 5306. The unit is used to connect or disconnect a driven shaft from a driving shaft while the latter is either running or standing still. It was developed and is widely used in Europe for machine tools. The bulletin gives engineering information on how to apply, how it operates, and control. Specifications are listed. Rectifier Div., I-T-E Circuit Breaker Co.

PIPE, TUBING, & HOSE

242—Hard Rubber Pipe

Physical and electrical properties of hard rubber pipe and fittings are discussed in 4-page folder 96A. A chart shows the resistance of the material, described as being a heat and chemical resistant synthetic hard rubber compound, to various chemicals. Available sizes are tabulated. American Hard Rubber Co.

243—Flexible Metal Hose

Various types of flexible hose applications are pictured in 6-page folder CMH 122R. Basic types, as well as standard assemblies and special purpose types, are discussed. A chart shows the proper type of assembly to use for handling various types of liquids, gases, solids, and semi-solids. Flexonics Corp.

TO REQUEST FREE BULLETINS

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

VALVES & REGULATORS

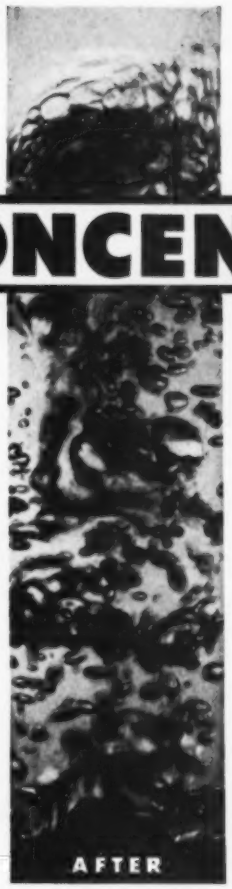
244—Regulating Equipment

Specifications and operational data for steam, gas, air, oil, and water regulating equipment are presented in 64-page catalog 53. Descriptions are given for pressure, temperature, and combination pressure and temperature regulators; diaphragm valves; motor operator valves; float valves; pop valves; strainers; solenoid and motor valves; and water gages. In addition to capacity tables, engineering data includes flange charts, a table of steam pressures and corresponding temperatures, and a table of water heads and equivalent pressures. O. C. Keckly Co.

245—Safety Shut-Off Valve

How a temperature actuated, automatic, shut-off safety valve can be used to check fuel-fed fires is explained in a 4-page folder. The valve can be used on any type of line, either liquid or gas, at any pressure. In addition to giving advantages, construction features, and specifications, the bulletin illustrates typical installations. Valco Inc.

(Continued on page 112)



Laboratory demonstration shows foaming of highly alkaline solution in glass test cylinder.

Same solution after addition of 12 ppm of Bird-Archer Concentrol antifoam.

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LOW COST CHEMICAL METHOD

FOR CONTROLLING FOAM

AND BOILER WATER CARRYOVER

LABORATORY PROOF

● Tests and plant operating records in all parts of the country have established the effectiveness and economy of Concentrol chemical treatment to combat wet steam problems. Where boiler water carryover is caused by foaming due to high alkalinity and high proportion of dissolved solids in the water, Concentrol is essentially a surface active agent that causes breakdown of bubble film, preventing foam formation.

Concentrol is supplied in liquid, powder or briquette form—can be fed either continuously or in slugs to boilers. Formulations of Concentrol can include organic sludge conditioning agents and other water treatment chemicals for boiler treatment as well as antifoam. Concentrol eliminates the need for costly pre-treatment of water and high blow-down rate. It is fast acting and resistant to hydrolysis or breakdown under normal boiler temperatures and pressures.

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Dart seats are wider and spherically ground to a true ball joint. You get a *drop-tight* joint without excessive wrenching. Yes, and you can use Darts over and over again to cut your costs!

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DART UNIONS

new bulletins

(Continued from page 111)

246—Solenoid Valves

Engineers concerned with the use of solenoid valves should find considerable information of value in 80-page catalog 24. A quick-reference index increases the usefulness of this booklet. Charts are presented to aid in selecting the correct unit for any application. Nomographs give flow of water, air and gas, and steam for standard full area valves. Descriptions and specifications for many types of packless and packed units are presented. Automatic Switch Co.

WATER TREATMENT & WASTE DISPOSAL

247—Feedwater Demineralization

Mixed bed and two-step demineralization to meet specifications of high pressure boiler feedwater is discussed in 16-page reprint 3836. Economic aspects of demineralizing various water supplies are discussed. Cost comparisons are outlined, make-up water requirements are specified, and curves show economies of operation. The Permutit Co.

TO REQUEST ADDITIONAL DATA

Insert "key" numbers on return post card found on page 115. Your requests will be handled promptly.

248—Strainers

Self-cleaning strainers for removal of fine suspended particles from raw or process water are described in a 12-page booklet. Operating principles, advantages, and construction features are discussed. Dimensions and operating capacities are tabulated. Various types of straining media also are presented. S. P. Kinney Engineers, Inc.

249—Zeolite Water Softeners

Water softening by ion exchange is the subject of 12-page bulletin WC-108. It explains the distinction between the sodium and hydrogen cycle, and shows differences in results obtained by the two processes. Design and operation of zeolite equipment is described, and available methods for controlling various operations are discussed. An appraisal of ion exchange materials includes a table of characteristics. A simple method of sizing zeolite softeners and a table of recommended flow rates aids in determining equipment to meet specific requirements. Graver Water Conditioning Co.

MISCELLANEOUS

250—LP Gas Vaporizers

LP gas steam vaporizers for stand-by peak shaving or continuous service in both industrial plants and utilities are the subject of 4-page folder 8-52. Specifications, installation data, capacities, and a cut-away scale drawing showing the unit's construction are included. Roth Manufacturing Co.

—*End*

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These concrete stave silos are built to support heavy equipment loads such as conveyors, shaker screens or collectors on the top or on the sides.

Whatever the materials you store and handle, MARIETTA concrete silos will improve your operations, cut your costs, give you permanent, yet flexible storage facilities. Write today for recommendations, installation case histories.

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REDUCED PRESSURE CONTROL
for Steam Air or Gas

Davis No. 14B Diaphragm Motor Valve

The new DAVIS No. 14B diaphragm motor valve incorporates design features that give you better control with more dependability. Enclosed yoke, lubricated stuffing box and valve stem position indicator are features that make this valve easier to service and shows at a glance the position of the inner valve.

The No. 14B is ideal for pressure control or relief, or for back pressure service on steam, air or gas. Features spring loaded, balanced type inner valve; direct or reverse action. The 14B is available in bronze, semi-steel or steel body . . . special trim available for corrosive services. Sizes range from ½ to 14" . . . Initial pressures to 1500 p.s.i. . . . Reduced pressures from 1000 to 1 p.s.i.

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Keeps motors running like new... The easy, fast way to restore commutators and slip rings — WITHOUT DISMANTLING! — Substitutes low-cost prevention and correction for high-cost repair and rebuilding — COSTS LITTLE, SAVES A LOT.

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Refinish commutators and rings to like-new condition even when ridged, scored or burned.

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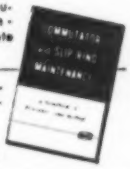
Stop sparking — help commutation — prolong brush life. For all sizes of commutators.

PRECISION GRINDERS
For more than surface smoothing—under machine's own power. Accurate to .001".

FLEXIBLE ABRASIVE
Cleans and burnishes commutators. Non-dusting. Complete size range.



FREE 39-page Handbook — Complete information on commutator maintenance. MAIL COUPON.

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Actually cuts fuel costs

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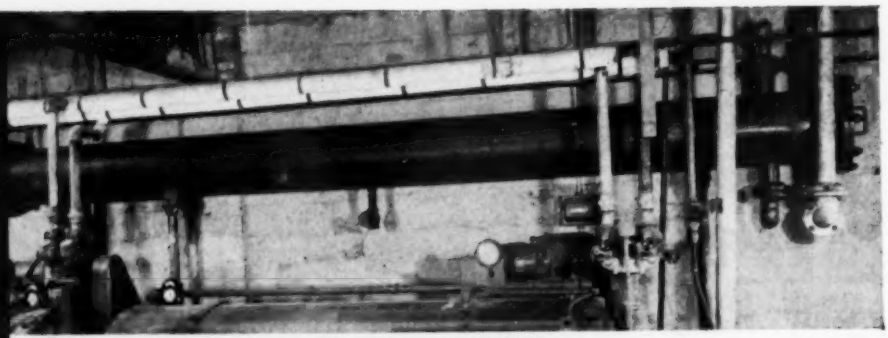
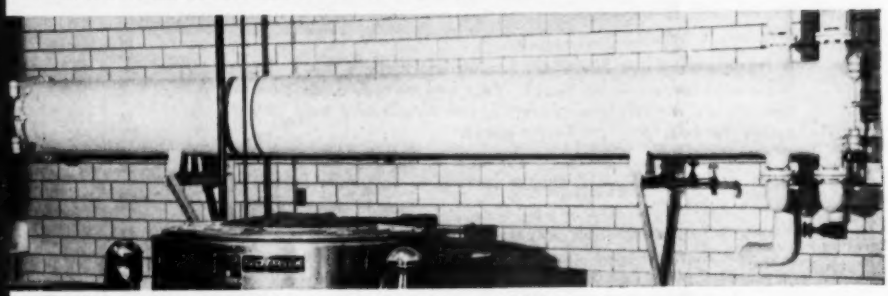
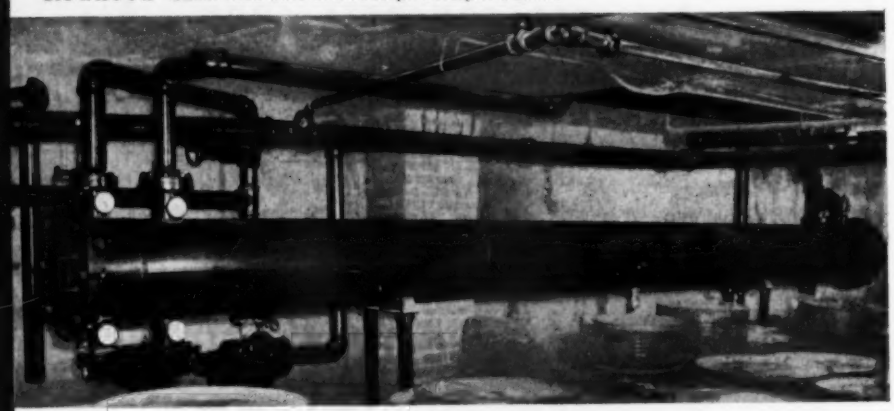


Saves a third on fuel costs at Domestic Laundry, Baltimore



Reduces boiler load 30% at St. Joseph's Hospital, Elmira



Eliminates an extra boiler at Brown's Laundry, Allentown

How much fuel are you firing down your sewer?

Typical users of Kelley waste water heat reclaimers are saving up to one-third of fuel costs—$4000 per year at United Laundries in Boston for example!

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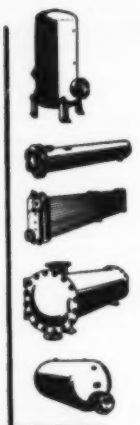

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readers' guide

. . . to advertised products

AIR FILTERS & DUST COLLECTORS

Aerotec series mechanical-electrical dust collectors are described on p 34. The Thermix Corp.

Key No. 500—Cat 4-P201 describes Prat-Daniel tubular dust collectors with the decantation principle. The Thermix Corp. p 32.

Key No. 501—Booklet, "The Collection and Recovery of Industrial Dusts." Buell Engineering Co. p 28.

PROTECTIVE COATINGS

Key No. 502—Coupon p 63 offers data on cutting wire fence re-coating costs with Rust Oleum lambs wool roller. Rust-Oleum Corp.

BOILERS & BOILER ACCESSORIES

Key No. 503—Catalog 501 contains descriptive data on Stowe stokers. The Johnston & Jennings Co. p 25.

Key No. 504—Complete details on Superior water-tube steam generators are described in Cat 502 W. Superior Combustion Industries, Inc. p 4.

Key No. 505—Brochure on binfeed stokers contains blue-prints and plan of model stoker installation. Canton Stoker Corp. p 48.

Descriptive literature available on Wickes steam generators. The Wickes Boiler Co. p 133.

Key No. 506—Cat 502 contains complete details on Superior packaged steam generators. Superior Combustion Industries. p 17.

Key No. 507—Bull EC-52B describes Econotherm packaged boilers. Dutton Boiler Div., Hapman Dutton Co. p 61.

Adv. p 64 offers catalog and specifications on the Petro industrial oil burner. Petro Division.

Adv. p 44 gives information on perfect spread stokers by American Engineering Co.

Adv. p 131 describes Enco dual fuel-oil heating and pumping set. The Engineer Co.

Adv. p 22, 23 contains information on Riley steam generating units. Riley Stoker Corp.

Adv. p 119 contains data on Kewanee heavy-duty steel boilers. Kewanee-Ross Corp.

See adv. p 47 for information on Beacon coal. Eastern Gas & Fuel Assoc.

Adv. p 14, 15 contains information on bituminous coal. Bituminous Coal Institute.

Adv. p 109 contains information on coals by General Coal Co.

Key No. 508—Facts and case histories available on Marietta concrete storage tanks. The Marietta Concrete Corp. p 113.

Full details are available on the Elliott deaerating heater described on p 18, 19. Elliott Co., Deaerator & Heater Dept.

Adv. p 103 contains information on Heacon dampers designed to meet practically any pressure or temperature specifications. The Thermix Corp.

BUILDING MATERIALS & MAINTENANCE

Key No. 509—Free Repair Handbook describes Smooth-On repairs. Smooth-On Mfg. Co. p 125.

Adv. p 129 contains data on electro-forged steel grating. Blaw-Knox Equip. Div., Blaw-Knox Co.

DIESELS & GAS ENGINES

See adv. p 26, 27 for data on CP diesel dual fuel, and gas engines. Chicago Pneumatic Tool Co.

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NOTE—This department is both a product index for advertising and a keyed listing for advertised literature. Refer to advertisement on page indicated and contact advertiser directly—or list paragraph key numbers on reader service card (page 115) to get data you want

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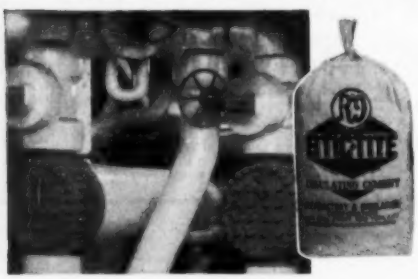

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(Continued from page 117)

ELECTRICAL EQUIPMENT

Adv. p 107 contains information on the Murray turbo-generator. Murray Iron Works Co.

Key No. 510—"How to Use Capacitors to Reduce Power Costs," booklet GEA-5632. General Electric Co. p 53.

Key No. 511—G-E boiler feed pump motor is described in Bull GEA-5813. General Electric Co. p 65.

Key No. 512—Bull 1410 contains information on Heinemann circuit breakers. Heinemann Electric Co. p 104.

Key No. 513—Bull 7004-B contains complete details on I-T-E metal-clad switchgear. I-T-E Circuit Breaker Co. p 30, 31.

Key No. 514—Coupon on p 113 offers free handbook on commutator and slip ring maintenance. Ideal Industries, Inc.

ENGINES & TURBINES

Key No. 515—Data on Terry solid-wheel turbine are contained in Bull S-116. The Terry Steam Turbine Company, p 35.

FANS & BLOWERS

Key No. 516—Coupon on p 2 offers centrifugal blower Cat B-10 with complete data. Hartzell Propeller Fan Co.

Key No. 517—Coupon on p 41 will bring complete information on Coppus blowers and exhausters. Coppus Engineering Corp.

FILTERS, STRAINERS, & PURIFIERS

Key No. 518—Coupon on p 54 offers bulletin on Cuno Micro-Klean filters. Cuno Engineering Corp.

HEAT EXCHANGER EQUIPMENT

Key No. 519—Cat 310 contains information on p-k heat reclaiming equipment, storage heaters and condensate coolers. The Patterson-Kelley Company, Incorporated. p 114.

Literature available on Airetool tube cleaners and expanders for heat exchanger and condenser tubes. Airetool Mfg. Co. p 130.

Adv. p 125 describes Wilson cleaning and application kit for maintenance of condensers and heat exchangers. Thomas C. Wilson, Inc.

HEATING, AIR CONDITIONING, & REFRIGERATION

Adv. p 127 contains information on Powers pneumatic systems of temperature and humidity control. The Powers Regulator Co.

Key No. 520—Coupon on p 55 offers bulletins on Chromalox electric Far-infrared units. Edwin L. Wiegand Co.

INSTRUMENTS & CONTROLS

Key No. 521—Testing instrument bulletins: wattmeter (GEC-951); pyrometer (GEC-836); volt ammeter (GEC-901). General Electric Co. p. 60.

Key No. 522—Details available on Liquidometer tank gage. The Liquidometer Corp. p 126.

Key No. 523—Hays electronic flow meter is described in Bull 52-1074-222. The Hays Corporation. p 45.

Key No. 524—Literature available on Weston all-metal thermometers. Weston Electrical Instrument Corp. p 110.

LUBRICANTS & LUBRICATION EQUIPMENT

Adv. p 57 gives advantages of Stanogear compounds for extreme-pressure lubrication. Standard Oil Co. (Indiana).

Key No. 525—Instructive bulletin and free testing sample of Non-Fluid Oil. New York & New Jersey Lubricant Co. p 123.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly.

Key No. 526—Literature describes complete line of Hilco purifiers, filters, reclaimers and conditioners. The Hilliard Corp. p 6.

Adv. p 51 contains data on Gascon oil for diesel lubrication. Sinclair Refining Company.

Key No. 527—New booklet describes Sunep for eliminating failure of slow-speed worm gears. Sun Oil Co. p 99.

MATERIALS OF CONSTRUCTION

Key No. 528—Corrosion-resisting Monel is described in "How to Get Longer Service From Your Pumps." The International Nickel Co., Inc. p 38.

MATERIALS HANDLING EQUIPMENT

Key No. 529—Dings magnet or magnetic separator for tramp iron problems is described in Bull C-5000-B. Dings Magnetic Separator Co. p 124.

Adv. p 46 contains information on G-W automatic coal handling systems. Gifford-Wood Co.

Key No. 530—Car shakers and rotary dumpers are described in Books 2345 & 2048-A. Link-Belt Co. p 101.

(Continued on page 120)

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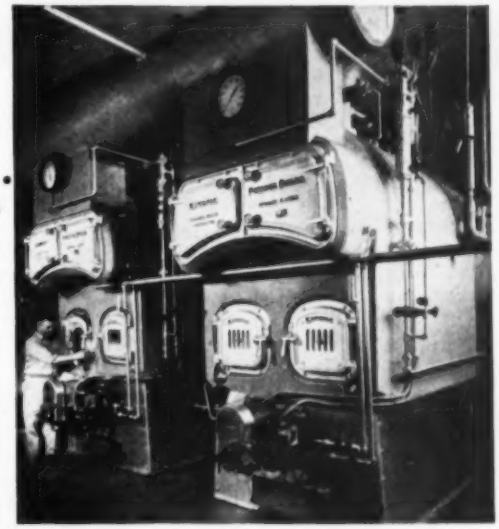

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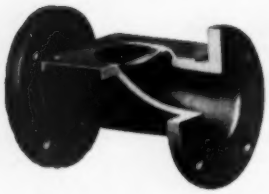

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By offering such a broad selection of operators, diaphragms and bodies, Hills-McCanna is able to furnish so many standard combinations that the user is in the position of being able, in most cases, to find the exact valve that best fits his individual requirements. There is virtually never any need to adapt to your service a valve developed for someone else's needs.

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saunders patent diaphragm valves

Also Manufacturers of Proportioning Pumps Force Feed Lubricators • Magnesium Alloy Castings

readers' guide

(Continued from page 119)

Adv. p 24 contains information on Manzel chemical feeders and hypochlorinators. Manzel, Inc.

MECHANICAL POWER TRANSMISSION

Key No. 531—Catalog and handy selector charts available on Lovejoy flexible couplings. Lovejoy Flexible Coupling Co. p 123.

Adv. p 3 describes the new Thor rayon belt for heavy-duty transmission belt drives. Goodyear Tire & Rubber Co.

Key No. 532—Bull 6868 contains engineering facts on Condor V-belts. Raybestos-Manhattan Inc., Manhattan Rubber Div. p 39.

Adv. p 21 contains data on Gates Vulco ropes. The Gates Rubber Co.

Available literature describes solid steel collars. Hallowell Power Transmission Div., Standard Pressed Steel Co. p 132.

Key No. 533—Catalog 150 describes Hyatt Hy-Load roller bearings. Hyatt Bearings Div., General Motors Corporation. p 58.

PACKINGS AND GASKETS

Adv. p 56 contains information on R/M's Big 7 packing types. Raybestos-Manhattan, Inc., Packing Div.

Key No. 534—Bulls 4502 & 4401 contain data on Pumcups for air and hydraulic mechanisms and for reciprocating pumps. Darling Valve & Mfg. Co. p 106.

PIPE, TUBING & HOSE

Key No. 535—"Report on Economy of Rubber-Lined Pipe" contains case histories on corrosion protection. La Favorite Rubber Mfg. Co. p 126.

Key No. 536—Folder "Flexineering" contains details on Penflex flexible tubing. Pennsylvania Flexible Metallic Tubing Co., Inc. p 52.

Key No. 537—Cat EJ-1912 contains data on Gun-Pakt expansion joints. Yarnall-Waring Co. p 66.

Key No. 538—Bulletin "Wrought Iron For Piping Systems" contains data on this product. A. M. Byers Co. p 43.

Key No. 539—Cat 130 gives full information on all CMH flexible metal hose. Chicago Metal Hose Div., Flexonics Corp. p 42.

Adv. p 112 contains information on Dart unions. Dart Union Co.

Key No. 540—Free sample of Key graphite paste and pipe joint compound offered on p 132. Key Company.

PUMPS & COMPRESSORS

Key No. 541—Bull 105-M contains details on Aurora Type-OD centrifugal pump. Aurora Pump Co. p 132.

Adv. p 37 describes Worthington vertical turbine pumps. Worthington Corp., Vertical Turbine Pump Div.

Key No. 542—Worthington's SESC pump line is described in Bull W300 B-4. Worthington Corp., Centrifugal Pump Div. p 40.

Key No. 543—Latest bulletins available on Cooper-Bessemer motor-driven air compressors. The Cooper-Bessemer Corp. p 9.

Key No. 544—Data on Hoffman vacuum pumps are contained in Cat VP 852. Hoffman Specialty Mfg. Corp. p 33.

Key No. 545—Bull 351 contains facts on Milton Roy air-powered controlled volume pumps and their application. Milton Roy Co. p 59.

Key No. 546—Descriptive literature available on Orchem Little Giant pumps for water softening, boiler treatment and chemical applications. Orchem Pump Div. p 109.

REFRACTORIES

Key No. 547—Adv. p 118 offers free sample bag of Stic-Tite insulating cement. Refractory & Insulation Corp.

STEAM SPECIALTIES

Key No. 548—Bull 35 contains data on Illinois steam traps. Illinois Engineering Co. p 129.

Key No. 549—Cat 68-I describes Strong No. 070 semi-steel traps. Strong, Carlisle & Hammond Co. p 129.

Key No. 550—Coupon on p 134 offers book "Solving Steam Trap Problems." The V. D. Anderson Co.

Key No. 551—Bulletin describes Armstrong Y-type strainers for steam, air, gas, water or oil. Armstrong Machine Works. p 132.

TOOLS

Adv. p 131 contains data on Skinner valve and bibb reseater. M. B. Skinner Company.

Key No. 552—104-page handy reference book of 4,000 time-saving tools for production and maintenance. Snap-On Tools Corp. p 121.

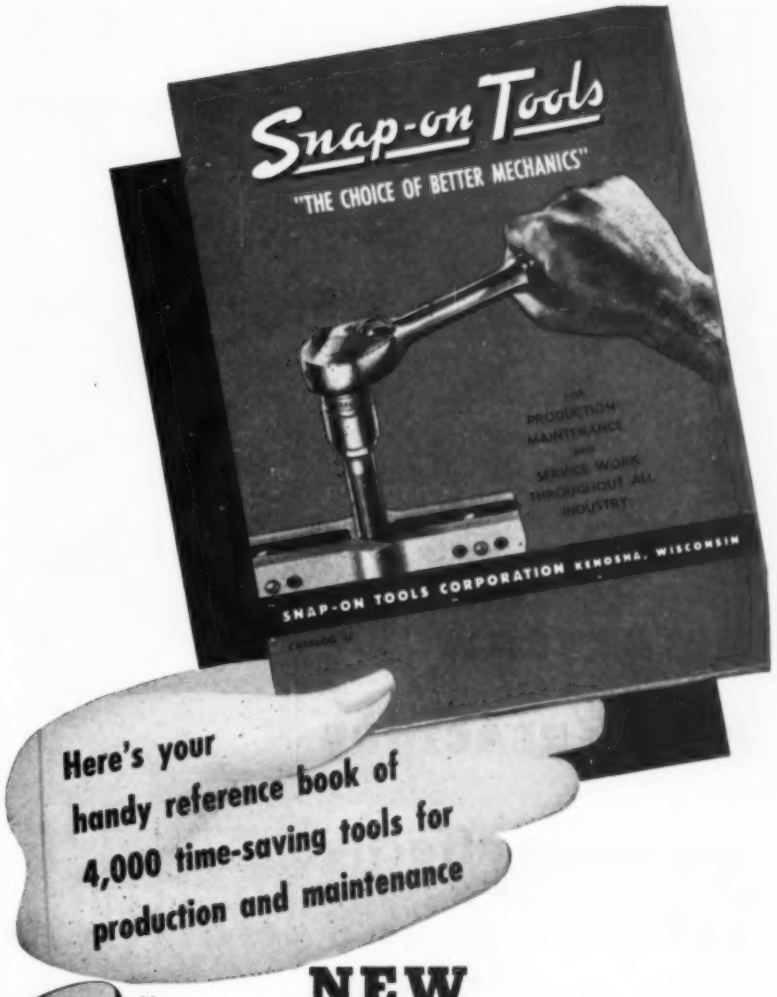
VALVES & REGULATORS

Key No. 553—Valve catalog contains data on Rockwell butterfly valves. W. S. Rockwell Co. p 131.

Key No. 554—Bulletin describes Everlasting valves with duplex blow-off units. Everlasting Valves. p 108.

Key No. 555—Catalog No. 30 contains data on Chapman tilting disc check

(Continued on page 122)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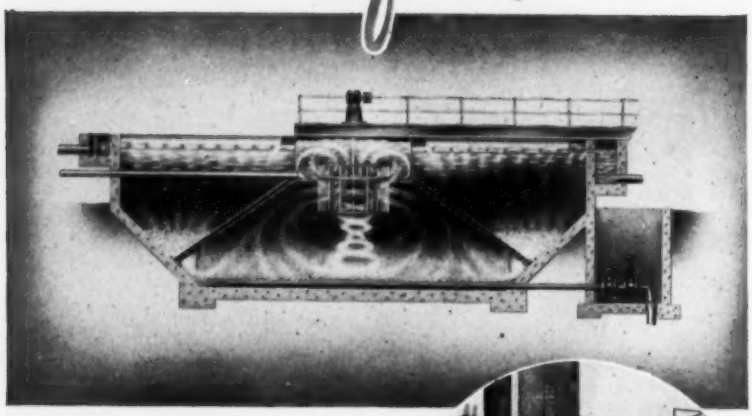

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readers' guide

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valves. The Chapman Valve Mfg. Co. p 49.

Key No. 556—Catalog gives 4 ways to cut pump repairs. Sims Pump Valve Co., Inc. p 126.

Adv. p 36 contains data on the complete line of Vogt valves, fittings and flanges. Henry Vogt Machine Co.

Key No. 557—36-page Cat V-52 gives full details on all Hills-McCanna valves. Hills-McCanna Co. p 120.

Full information available on the Davis 14B regulator for reduced pressure control. Davis Regulator Co. p 113.

Key No. 558—Bulls B-424 and B-433 contain information on Yarway blow-off valves. Yarnall-Waring Co. p 10, 11.

Detailed data units available on all Jerguson valves described on p 123. Jerguson Gage & Valve Co.

Crane diaphragm valves are described on p 7. Crane Co.

Key No. 563—Full details on Spence temperature regulators is given in Bull T50. Spence Engineering Co., Inc. p 105.

HOW TO REQUEST FREE LITERATURE

Insert "key" numbers on return post card found on page 115. Our Reader's Service Department will handle your request promptly.

WATER TREATMENT & WASTE DISPOSAL

Key No. 559—Complete literature and bi-monthly reports on Amberlite deionization available. Rohm & Hass Company. p 29.

Adv. p 122 describes American 3-stage reactors for effective water softening and clarifying. American Water Softener Co.

Key No. 560—Bulletin describes Inversand water softening system. Hungerford & Terry, Inc. p 125.

Key No. 561—Bull 49 gives details on Nalco water treatment for package boilers. Bull 46 tells of SR-155 fuel oil additive. National Aluminate Corp. p 13.

Adv. p 111 describes Bird-Archer's 8 point water treatment service. The Bird Archer Co.

Key No. 562—Free copy of "Trends in Application of Deaerating Heaters for Treatment of Boiler Feedwater." Graver Water Conditioning Co. p 62.

Elgin water conditioning systems for every need are described on p 50. Elgin Softener Corp.

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JERGUSON VALVES
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OS&Y Valves for severe conditions

Rugged Jerguson OS&Y Valves are the ideal answer to meet high temperature or corrosive conditions where inside threads can't be tolerated. Efficient outside thread design eliminates possible freezing and allows the valve stem to work freely at all times.

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NON-FLUID OIL is not the name of a general class of lubricants, but is a specific product of our manufacture.

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- provide maximum alignment correction for smooth power transmission
- dampen and absorb vibration, starting torque, and shock of intermittent loads
- increase operational efficiency and economy
- protect motor and machine
- lengthen service life

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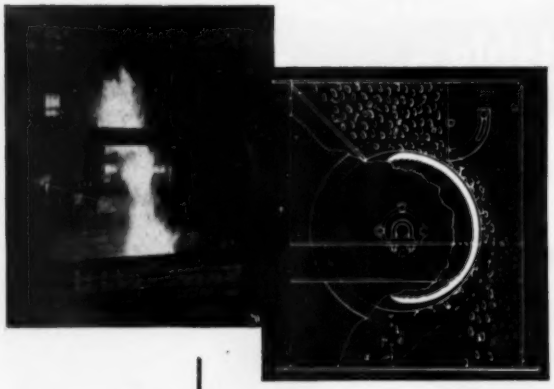
POWERFUL, non-electric Dings Perma-Drums and Drum type Separators can pull out tramp iron before it causes production headaches. They're easily installed in chutes or ducts, and the tough, armor-plate drum shell handles dry, wet or flaming hot material (below, left). Stationary Perma-Drum Alnico Magnets use no current, lose no magnetic strength, are guaranteed for the physical life of the unit.



how they work

1 Tramp Iron held fast to drum shell by magnetic pull.

2 Non-magnetics flow over shell in normal trajectory.

3 Tramp Iron is discharged separately when it passes out of magnetic field.

DINGS RECTANGULAR SUSPENDED MAGNETS

DINGS MAGNETIC PULLEYS

There's a Dings Magnetic Separator for every tramp iron problem — *write* DINGS MAGNETIC SEPARATOR CO., 4736 W. Electric Ave., Milwaukee 46, Wisconsin for BULLETIN C-5000-B *today.*

PD 153

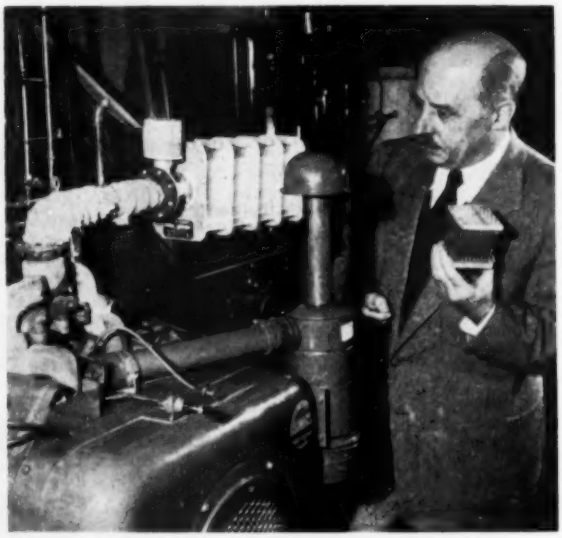
DINGS Magnets

spot news

(Continued from page 100)

is the problem of corrosion and scaling in the evaporators. Escher Wyss has done considerable work in this connection.

The arrangement between the two companies will entail the Americanization of Swiss designs, and the establishment of sales and service organizations. In anticipation of expanded production, Cleaver-Brooks is pressing new construction at its main plant in Milwaukee to ready approximately 50,000 sq ft of factory space to handle manufacture of the new lines. Production is scheduled to start in the last half of 1953.



E. J. Houdry, inventor of the catalytic exhaust system, studies a unit undergoing test on a gasoline engine.

Muffler for Removing Engine Fumes Exhibited at Materials Handling Show

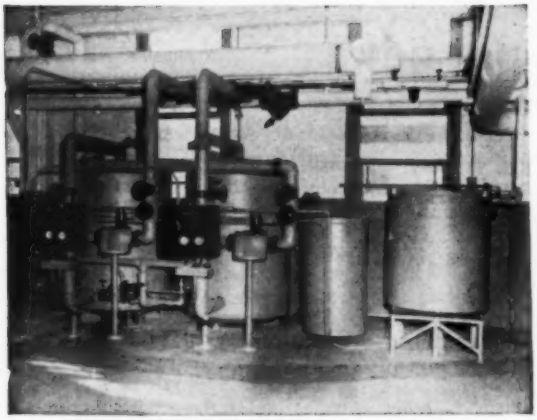
One of the more interesting exhibits at the recent Fifth National Materials Handling Exposition was a catalytic fork-truck muffler for removing noxious carbon monoxide and hyrocarbon exhaust fumes. Known as the OCM Catalytic Exhaust System, the new device permits drivers to operate fork-lift trucks in confined plant areas with complete safety. It also prevents contamination of foodstuffs and other perishables that might be tainted by fork-truck exhausts.

Basic unit of the muffler is the Oxycat, a device invented by E. J. Houdry, president of Oxy-Catalyst, Inc. Oxycat has recently received considerable attention in applications to combat air pollution and recover waste heat energy in industrial plant installations.

It consists of a cartridge containing spaced porcelain rods coated with a catalytic agent. The engine exhaust flows across the surface of the rods where combustion of carbon monoxide and other harmful vapors takes place. On leaving the catalyst, the exhaust contains mostly carbon dioxide and water vapor, and only slight traces of the original contaminants.

Mufflers are produced in standard sizes to meet requirements of any make or size of lift-truck. They contain two,

(Continued on page 126)



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Have you used the Smooth-On Foundry Cement made especially to correct blow holes, porous and rough spots, dents and other unsightly but harmless surface defects in otherwise sound *aluminum alloy castings?*

Applied like the widely used Smooth-On *Iron* Foundry Cement, Smooth-On No. 8 *Aluminum* Cement fills in evenly, hardens quickly, matches perfectly. Stays in place, too, for it expands slightly as it sets.

Smooth-On No. 8 Aluminum Cement comes in 1- and 5-lb. sizes. 1 lb. will fill 17 cu. in. Order it by NAME AND NUMBER from your supply house. If they haven't it, write us. If you have not yet discovered Smooth-On No. 8, ask us for

FREE SAMPLE TO TEST

You'll receive also the famous 40-page SMOOTH-ON HANDBOOK, filled with industrial uses for the various Smooth-On Cements. 140 illustrations. Write today.

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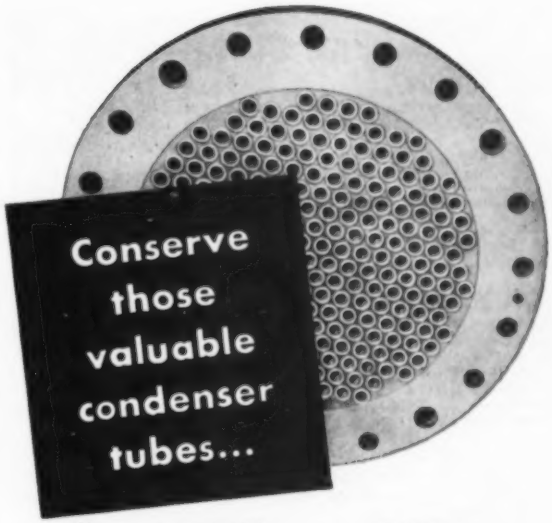
No. 8 ALUMINUM CEMENT



the Wilson Way

Usually a surface condenser tube fails in the first few inches of its length due to inlet end erosion. To protect against this costly deterioration, it is good practice to paint the tube sheets as well as the tube ends with a protective coating. This low-cost cleaning and application kit is designed to do the job quickly and efficiently. Only three simple steps are needed: (1) Clean all the tube ends. (2) Thin coating and squirt it into tube. (3) Attach the paint brush to the air motor and use it for fast, easy spreading.

This Wilson method insures complete removal of dirt, provides excellent paint adherence, makes certain paint is spread evenly on the tube. The work can be done in a hurry . . . with any labor available.

The Wilson Cleaning and Application Kit is but one of many Wilson accessories designed for the proper maintenance of condensers and heat exchangers. For packed condensers, there are packing tools, packing removal counterbores and ferrule wrenches. Wilson also makes a wide range line of tube cutters, tube expanders, flaring and belling tools, tube pullers, etc. TW 888

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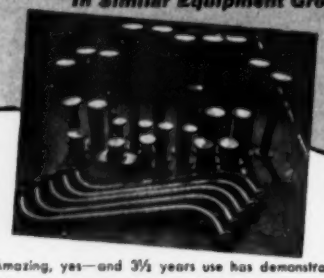

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Details a case history on rubber lined pipe that applies to corrosion protection in any field. You will find it a thought-provoking test that may reveal ways you can use the services of our RUBBER ENGINEERS.

Amazing, yes—and 3½ years use has demonstrated that this saving is no temporary affair.

Many case histories have proven the merit of the La Favorite method of lining and/or covering pipe, valves, tanks and special equipment with exclusive La Favorite rubber compounds.

They have confirmed the value of this method of protection against corrosion and other destructive forces.

They show that it has SAVED countless thousands of dollars for users—and that is what counts!!!

Some of the Ways we are helping others

Made furnisher rolls for printing textiles, developed non-toxic white rubber linings for food processing equipment, constructed special rolls for the new non-contact printing process, devised static absorbing rolls, and provided many other specials for troubled production executives.

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NEW JERSEY PROCESS PLANT SAVES NEW FEED PUMP COST

Expansion plans called for a new boiler, and the Chief Engineer thought he'd need a new feed pump too. Pumps on hand — two 10 x 6 x 10's — often needed repairs to meet existing demand. Leaking valves kept them below capacity most of the time. He tried Sims Pump Valves before the new installation was completed and found, even at slower speeds, his pumps still supplied all the water necessary. When the new boiler was put on the line, the same pumps with Sims Valves carried the load easily.

Three years later the Chief said, "Sims Valves were a good investment." They were — but he couldn't lose anyhow. Sims Valves were *guaranteed* to give him better performance — complete satisfaction.

See how Sims valves can help with your pump problems. Carried in stock to fit over 40 different makes of reciprocating pumps — and hundreds of sizes — they'll fit your pumps — improve performance. Free catalog shows how.

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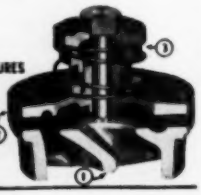

spot news

(Continued from page 124)

three, or more individual cartridges, depending on size of the truck engine. In most cases the muffler attaches to the engine manifold. Because of the streamlined shape of the catalyst rods, the unit does not create back pressure. It can be used on any engine operating on unleaded gasoline.

Boiler and Turbo-Generator Will Cross Critical Pressure Barrier

Plans to build a boiler and turbo-generating unit for operation above the critical pressure of steam have been announced by American Gas and Electric Co. The unit, which is expected to be the most efficient ever built, will mark the first time the critical pressure barrier has been exceeded in commercial production of electric power.

An agreement has been reached under which General Electric Co. will design and manufacture a 120,000 kw turbine for operation at 4500 psi, almost double the present highest steam pressure used for power generation. Initial steam temperature will be 1150 F, or approximately 50 degrees above the present highest. It will be followed by two stages of reheat; 1050 F and 1000 F.

The boiler, to be built by Babcock & Wilcox Co., will be a once-through, Universal-Pressure type. In this type, water at 5500 psi is pumped through and changed into super-

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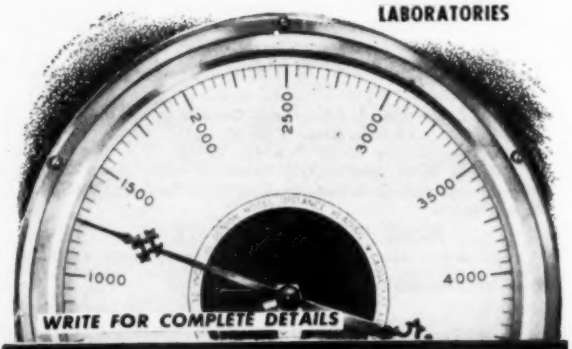

WRITE FOR COMPLETE DETAILS
THE LIQUIDOMETER CORP.
36-32 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

heated steam in a single, fast passage through the tubes. The boiler will be equipped with cyclone furnaces.

The entire project, cost of which will exceed $12 million, is being engineered by American Gas and Electric Service Corp., and will be installed at The Ohio Power Co.'s Philo plant near Zanesville, O.

In commenting on the development, Philip Sporn, president of AGE, pointed out that the project has resulted from more than 30 years of continuous work and research. "While boilers above the critical pressure of 3206 psi had been considered before, and while laboratory pressures above that value had been utilized, no practical design had ever been developed." He explained that, in the super-critical pressure range, water passes immediately into steam, without any intermediate stage of bubbling. In the new once-through boiler design, the steam drum and re-circulating pumps are therefore eliminated.

Detroit Utility To Install World's Largest Turbine-Generator

The largest steam turbine-generator unit in the world will be installed in the new River Rouge Station of The Detroit Edison Co. The turbine for the new unit, to be manufactured by General Electric Co., will be rated at 260,000 kw. Its generator, rated at 353,262 kva, is designed for conventional hydrogen cooling. The machine will be of the cross-compound, double-flow, reheat design.

Steam will enter the high pressure turbine at 2000 psi, and 1050 F. Exhaust from the high-pressure side of the turbine, at about 720 F, will be returned to the boiler to be reheated to 1000 F before entering the low-pressure side.

New Turbosupercharger Features Efficient Turbine and Compressor

Development of a new turbosupercharger for high-pressure service has been reported by DeLaval Steam Turbine Co. In describing the new unit, DeLaval's research engineer, R. Birmann, stated, "In solving the problem of better utilization of exhaust energy to precompress the combustion and scavenging air of a diesel engine, the design of the new turbosupercharger departs from standard practice in almost all essential respects."

The new unit is designed for a pressure ratio of 2 to 1 under full-load engine operating conditions, and slightly higher under engine overload conditions. Later models are being planned to be capable of producing ratios of 3 to 1 under engine full-load conditions.

One of the outstanding characteristics is the high efficiency of the turbine and compressor. The compressor is of the mixed-flow type, so-called because the air enters axially and flows through and out of the impellers partly axially and partly radially. Departure from conventional practice also has been made in the turbine design. A mixed-flow centripetal turbine is used instead of the axial-flow type.

All working parts of the new unit are at one end, thus leaving the other free for driving a tachometer, or for a self-contained lube-oil system. The central partition assembly is water-cooled and offers a smooth surface for diffusion of hot incoming gases. A straight-through nozzle eliminates the need for bifurcated intake manifolds, and adjustability of the nozzle guide vanes makes it possible for one model to be quickly adjusted to any make of diesel.

—End

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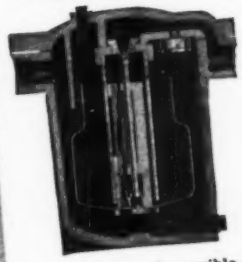
ILLINOIS Steam Trap



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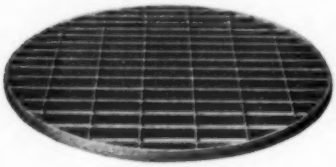

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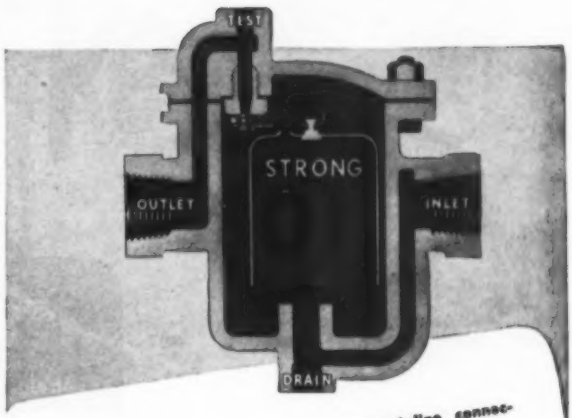

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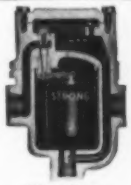
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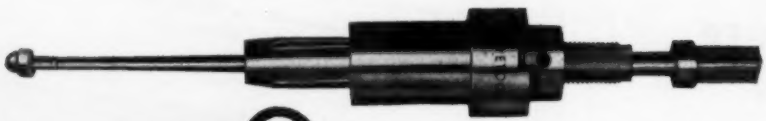

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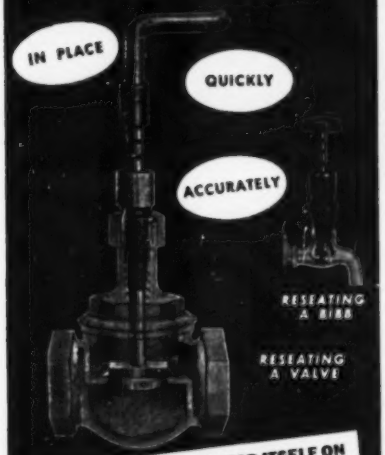

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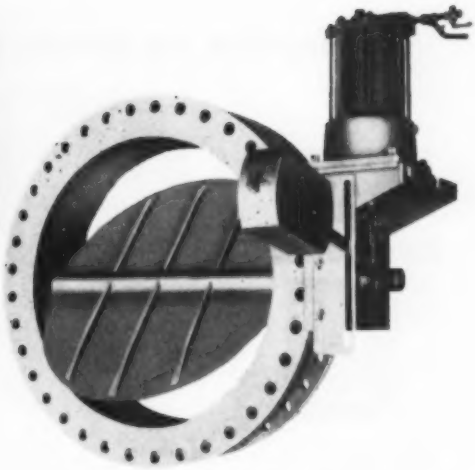

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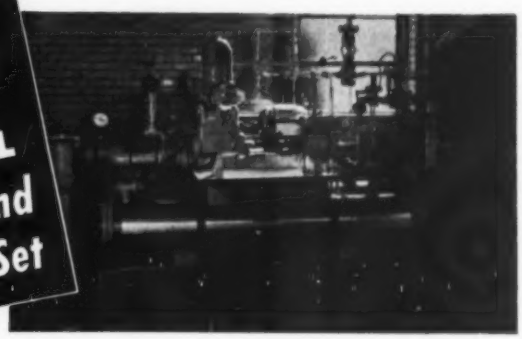

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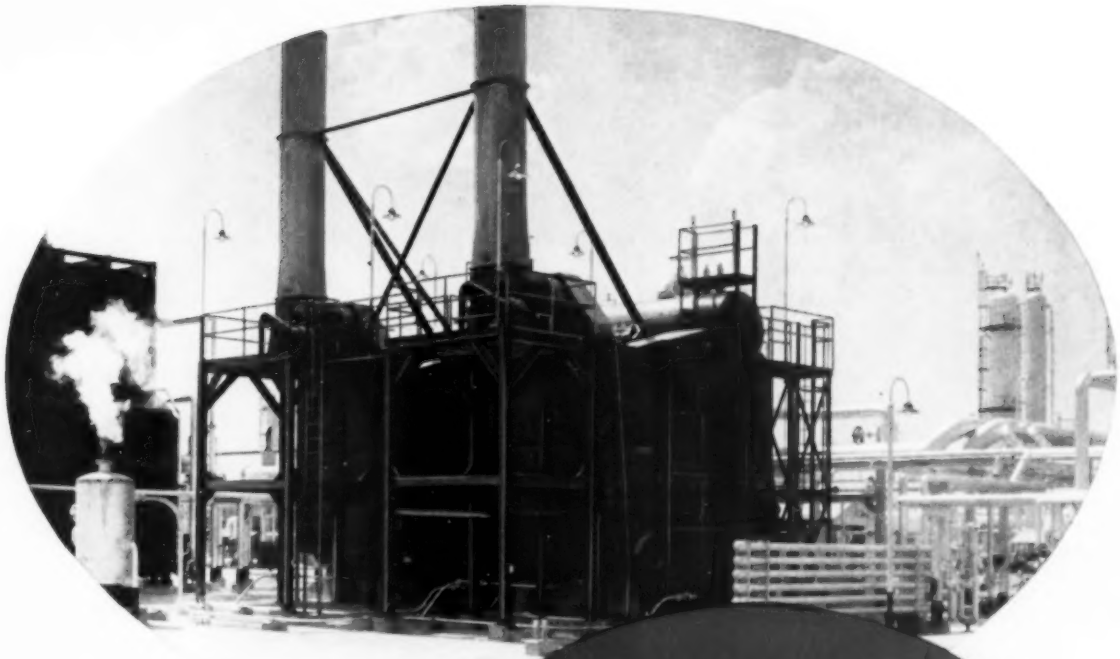

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